# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

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FRIDAY, JANUARY 1, 1904.

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## *SCIENTIFIC INVESTIGATION AND PROGRESS.**

AT the weekly services of many of our churches it is customary to begin with the reading of a verse or two from the Scriptures for the purpose, I suppose, of putting the congregations in the proper state of mind for the exercises which are to follow. It seems to me we may profit by this example, and accordingly I ask your attention to Article I. of the Constitution of the American Association for the Advancement of Science, which reads thus: ' The objects of the association are, by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of America, to give stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and a wider usefulness.'

The first object mentioned, you will observe, is ' to promote intercourse between those who are cultivating science in different parts of America ' ; the second is ' to give a stronger and more general impulse and more systematic direction to scientific research ' ; and the third is ' to procure for the labors of scientific men increased facilities and a wider usefulness.' Those who are familiar with the history of the association are well aware that it has served its purposes admirably, and I am inclined to think that those who have been

* Address of the retiring president of the American Association for the Advancement of Science, St. Louis meeting, December 28, 1903.

in the habit of attending the meetings will agree that the object which appeals to them most strongly is the promotion of intercourse between those who are cultivating science. Given this intercourse and the other objects will be reached as a necessary consequence, for the intercourse stimulates thought, and thought leads to work, and work leads to wider usefulness.

While in 1848, when the association was organized and the constitution was adopted, there was a fair number of good scientific investigators in this country, it is certain that in the half century that has passed since then the number of investigators has increased very largely, and naturally the amount of scientific work done at present is very much greater than it was at that time. So great has been the increase in scientific activity during recent years that we are apt to think that by comparison scientific research is a new acquisition. In fact there appears to be an impression abroad that in the world at large scientific research is a relatively new thing, for which we of this generation and our immediate predecessors are largely responsible. Only a superficial knowledge of the history of science is necessary, however, to show that the sciences have been developed slowly, and that their beginnings are to be looked for in the very earliest times. Everything seems to point to the conclusion that men have always been engaged in efforts to learn more and more in regard to the world in which they find themselves. Sometimes they have been guided by one motive and sometimes by another, but the one great underlying motive has been the desire to get a clearer and clearer understanding of the universe. But besides this there has been the desire to find means of increasing the comfort and happiness of the human race.

A reference to the history of chemistry will serve to show how these motives have operated side by side. One of the first great incentives for working with chemical things was the thought that it was possible to convert base metals like lead and copper into the so-called noble metals, silver and gold. Probably no idea has ever operated as strongly as this upon the minds of men to lead them to undertake chemical experiments. It held control of intellectual men for centuries and it was not until about a hundred years ago that it lost its hold. It is very doubtful if the purely scientific question whether one form of matter can be transformed into another would have had the power to control the activities of investigators for so long a time; and it is idle to speculate upon this subject. It should, however, be borne in mind that many of those who were engaged in this work were actuated by a desire to put money in their purses—a desire that is by no means to be condemned without reserve, and I mention it not for the purpose of condemning it, but to show that a motive that we sometimes think of as peculiarly modern is among the oldest known to man.

When the alchemists were at work upon their problems, another class of chemists were engaged upon problems of an entirely different nature. The fact that substances obtained from various natural sources and others made in the laboratory produce effects of various kinds when taken into the system led to the thought that these substances might be useful in the treatment of disease. Then, further, it was thought that disease itself is a chemical phenomenon. These thoughts, as is evident, furnish strong motives for the investigation of chemical substances, and the science of chemistry owes much to the work of those who were guided by these motives.

And so in each period as a new thought has served as the guide we find that men

have been actuated by different motives, and often one and the same worker has been under the influence of mixed motives. Only in a few cases does it appear that the highest motives alone operate. We must take men as we find them, and we may be thankful that on the whole there are so many who are impelled by one motive or another or by a mixture of motives to take up the work of investigating the world in which we live. Great progress is being made in consequence and almost daily we are called upon to wonder at some new and marvelous result of scientific investigation. It is quite impossible to make predictions of value in regard to what is likely to be revealed to us by continued work, but it is safe to believe that in our efforts to discover the secrets of the universe only a beginning has been made. No matter in what direction we may look we are aware of great unexplored territories, and even in those regions in which the greatest advances have been made it is evident that the knowledge gained is almost insignificant as compared with that which remains to be learned. But this line of thought may lead to a condition bordering on hopelessness and despondency, and surely we should avoid this condition, for there is much greater cause for rejoicing than for despair. Our successors will see more and see more clearly than we do, just as we see more and see more clearly than our predecessors. It is our duty to keep the work going without being too anxious to weigh the results on an absolute scale. It must be remembered that the absolute scale is not a very sensitive instrument, and that it requires the results of generations to affect it markedly.

On an occasion of this kind it seems fair to ask the question: What does the world gain by scientific investigation? This question has often been asked and often answered, but each answer differs in some respects from the others and each may be suggestive and worth giving. The question is a profound one, and no answer that can be given would be satisfactory. In general it may be said that the results of scientific investigation fall under three heads—the material, the intellectual and the ethical.

The material results are the most obvious and they naturally receive the most attention. The material wants of man are the first to receive consideration. They can not be neglected. He must have food and clothing, the means of combating disease, the means of transportation, the means of producing heat and a great variety of things that contribute to his bodily comfort and gratify his esthetic desires. It is not my purpose to attempt to deal with all of these and to show how science is helping to work out the problems suggested. I shall have to content myself by pointing out a few of the more important problems the solution of which depends upon the prosecution of scientific research.

First, the food problem. Whatever views one may hold in regard to that which has come to be called 'race suicide,' it is certain that the population of the world is increasing rapidly. The desirable places have been occupied. In some parts of the earth there is such a surplus of population that famines occur from time to time, and in other parts epidemics and floods relieve the embarrassment. We may fairly look forward to the time when the whole earth will be overpopulated unless the production of food becomes more scientific than it now is. Here is the field for the work of the agricultural chemist who is showing us how to increase the yield from a given area and, in case of poor and worn-out soils, how to preserve and increase their fertility. It appears that the methods of cultivating the soil are still comparatively crude, and more and more thorough inves-

tigation of the processes involved in the growth of plants is called for. Much has been learned since Liebig founded the science of agricultural chemistry. It was he who pointed out some of the ways by which it is possible to increase the fertility of a soil. Since the results of his investigations were given to the world the use of artificial fertilizers has become more and more general.

But it is one thing to know that artificial fertilizers are useful and it is quite another thing to get them. At first bone dust and guano were chiefly used. Then as these became dearer, phosphates and potassium salts from the mineral kingdom came into use.

At the Fifth International Congress for Applied Chemistry, held at Berlin, Germany, last June, Dr. Adolph Frank, of Charlottenburg, gave an extremely interesting address on the subject of the use of the nitrogen of the atmosphere for agriculture and the industries, which bears upon the problem that we are dealing with. Plants must have nitrogen. At present this is obtained from the great beds of saltpeter found on the west coast of South America—the so-called Chili saltpeter—and also from the ammonia obtained as a by-product in the distillation of coal, especially in the manufacture of coke. The use of Chili saltpeter for agricultural purposes began about 1860. In 1900 the quantity exported was 1,453,000 tons, and its value was about $60,000,000. In the same year the world's production of ammonium sulphate was about 500,000 tons, of a value of somewhat more than $20,000,000. Of these enormous quantities about three quarters finds application in agriculture. The use of these substances, especially of saltpeter, is increasing rapidly. At present it seems that the successful cultivation of the soil is dependent upon the use of nitrates, and the supply of nitrates is limited. Unless something is done we may look forward to the time when the earth, for lack of proper fertilizers, will not be able to produce as much as it now does, and meanwhile the demand for food is increasing. According to the most reliable estimations indeed the saltpeter beds will be exhausted in thirty or forty years. Is there a way out? Dr. Frank shows that there is. In the air there is nitrogen enough for all. The plants can make only a limited use of this directly. For the most part it must be in some form of chemical combination as, for example, a nitrate or ammonia. The conversion of atmospheric nitrogen into nitric acid would solve the problem, and this is now carried out. But Dr. Frank shows that there is another, perhaps more economical, way of getting the nitrogen into a form suitable for plant food. Calcium carbide can now be made without difficulty and is made in enormous quantities by the action of a powerful electric current upon a mixture of coal and lime. This substance has the power of absorbing nitrogen from the air, and the product thus formed appears to be capable of giving up its nitrogen to plants, or, in other words, to be a good fertilizer. It is true that this subject requires further investigation, but the results thus far obtained are full of promise. If the outcome should be what we have reason to hope, we may regard the approaching exhaustion of the saltpeter beds with equanimity. But, even without this to pin our faith to, we have the preparation of nitric acid from the nitrogen and oxygen of the air to fall back upon.

While speaking of the food problem, a few words in regard to the artificial preparation of foodstuffs. I am sorry to say that there is not much of promise to report upon in this connection. In spite of the brilliant achievements of chemists in the field of synthesis it remains true that thus

far they have not been able to make, except in very small quantities, substances that are useful as foods, and there is absolutely no prospect of this result being reached within a reasonable time. A few years ago Berthelot told us of a dream he had had. This has to do with the results that, according to Berthelot, are to be brought about by the advance of chemistry. The results of investigations already accomplished indicate that, in the future, methods will perhaps be devised for the artificial preparation of food from the water and carbonic acid so abundantly supplied by nature. Agriculture will then become unnecessary, and the landscape will not be disfigured by crops growing in geometrical figures. Water will be obtained from holes three or four miles deep in the earth, and this water will be above the boiling temperature, so that it can be used as a source of energy. It will be obtained in liquid form after it has undergone a process of natural distillation, which will free it from all impurities, including, of course, disease germs. The foods prepared by artificial methods will also be free from microbes, and there will consequently be less disease than at present. Further, the necessity for killing animals for food will no longer exist, and mankind will become gentler and more amenable to higher influences. There is, no doubt, much that is fascinating in this line of thought, but whether it is worth following, depends upon the fundamental assumption. Is it at all probable that chemists will ever be able to devise methods for the artificial preparation of foodstuffs? I can only say that to me it does not appear probable in the light of the results thus far obtained. I do not mean to question the probability of the ultimate synthesis of some of those substances that are of value as foods. This has already been accomplished on the small scale, but for the most part the synthetical processes employed have involved the use of substances which themselves are the products of natural processes. Thus, the fats can be made, but the substances from which they are made are generally obtained from nature and are not themselves synthetical products. Emil Fischer has, to be sure, made very small quantities of sugars of different kinds, but the task of building up a sugar from the raw material furnished by nature—that is to say, from carbonic acid and water—presents such difficulties that it may be said to be practically impossible.

When it comes to starch, and the proteids which are the other chief constituents of foodstuffs, the difficulties are still greater. There is not a suggestion of the possibility of making starch artificially, and the same is true of the proteids. In this connection it is, however, interesting to note that Emil Fischer, after his remarkable successes in the sugar group and the uric acid group, is now advancing upon the proteids. I have heard it said that at the beginning of his career he made out a program for his life work. This included the solution of three great problems. These are the determination of the constitution of uric acid, of the sugars and of the proteids. Two of these problems have been solved. May he be equally successful with the third! Even if he should be able to make a proteid, and show what it is, the problem of the artificial preparation of foodstuffs will not be solved. Indeed, it will hardly be affected.

Although science is not likely, within periods that we may venture to think of, to do away with the necessity of cultivating the soil, it is likely to teach us how to get more out of the soil than we now do, and thus put us in a position to provide for the generations that are to follow us. And this carries with it the thought that, unless scientific investigation is kept up,

these coming generations will be unprovided for.

Another way by which the food supply of the world can be increased is by relieving tracts of land that are now used for other purposes than the cultivation of foodstuffs. The most interesting example of this kind is that presented by the cultivation of indigo. There is a large demand for this substance, which is plainly founded upon esthetic desires of a somewhat rudimentary kind. Whatever the cause may be, the demand exists, and immense tracts of land have been and are still, devoted to the cultivation of the indigo plant. Within the past few years scientific investigation has shown that indigo can be made in the factory from substances, the production of which does not for the most part involve the cultivation of the soil. In 1900, according to the report of Dr. Brunck, Managing Director of the Badische Anilin- and Soda-Fabrik, the quantity of indigo produced annually in the factory 'would require the cultivation of an area of more than a quarter of a million acres of land (390 square miles) in the home of the indigo plant.' Dr. Brunck adds: "The first impression which this fact may be likely to produce, is that the manufacture of indigo will cause a terrible calamity to arise in that country; but, perhaps not. If one recalls to mind that India is periodically afflicted with famine, one ought not, without further consideration, to cast aside the hope that it might be good fortune for that country if the immense areas now devoted to a crop which is subject to many vicissitudes and to violent market changes were at last to be given over to the raising of breadstuffs and other food products." "For myself," says Dr. Brunck, "I do not assume to be an impartial adviser in this matter, but, nevertheless, I venture to express my conviction that the government of India will be rendering a very great service if it should support and aid the progress, which will in any case be irresistible, of this impending change in the cultivation of that country, and would support and direct its methodical and rational execution."

The connection between scientific investigation and health is so frequently the subject of discussion that I need not dwell upon it here. The discovery that many diseases are due primarily to the action of microscopic organisms that find their way into the body and produce the changes that reveal themselves in definite symptoms is a direct consequence of the study of the phenomenon of alcoholic fermentation by Pasteur. Everything that throws light upon the nature of the action of these microscopic organisms is of value in dealing with the great problem of combating disease. It has been established in a number of cases that they cause the formation of products that act as poisons and that the diseases are due to the action of these poisons. So also, as is well known, investigation has shown that antidotes to some of these poisons can be produced, and that by means of these antidotes the diseases can be controlled. But more important than this is the discovery of the way in which diseases are transmitted. With this knowledge it is possible to prevent the diseases. The great fact that the death rate is decreasing stands out prominently and proclaims to humanity the importance of scientific investigation. It is, however, to be noted in this connection that the decrease in the death rate compensates to some extent for the decrease in the birth rate, and that, if an increase in population is a thing to be desired, the investigations in the field of sanitary science are contributing to this result.

The development of the human race is dependent not alone upon a supply of food but upon a supply of energy in available

forms. Heat and mechanical energy are absolutely essential to man. The chief source of the energy that comes into play is fuel. We are primarily dependent upon the coal supply for the continuation of the activities of man. Without this, unless something is to take its place, man is doomed. Statistics in regard to the coal supply and the rate at which it is being used up have so frequently been presented by those who have special knowledge of this subject that I need not trouble you with them now. The only object in referring to it is to show that, unless by means of scientific investigation man is taught new methods of rendering the world's store of energy available for the production of heat and of motion, the age of the human race is measured by the extent of the supply of coal and other forms of fuel. By other forms of fuel I mean, of course, wood and oil. Plainly, as the demand for land for the production of foodstuffs increases, the amount available for the production of wood must decrease, so that wood need not be taken into account for the future. In regard to oil, our knowledge is not sufficient to enable us to make predictions of any value. If one of the theories now held in regard to the source of petroleum should prove to be correct, the world would find much consolation in it. According to this theory petroleum is not likely to be exhausted, for it is constantly being formed by the action of water upon carbides that in all probability exist in practically unlimited quantity in the interior of the earth. If this be true, then the problem of supplying energy may be reduced to one of transportation of oil. But given a supply of oil and, of course, the problem of transportation is solved.

What are the other practical sources of energy? The most important is the fall of water. This is being utilized more and more year by year since the methods of producing electric currents by means of the dynamo have been worked out. There is plainly much to be learned before the energy made available in the immediate neighborhood of the waterfall can be transported long distances economically, but advances are being made in this line, and already factories that have hitherto been dependent upon coal are making use of the energy derived from waterfalls. The more rapidly these advances take place the less will be the demand for coal, and if there were only enough waterfalls conveniently situated, there would be no difficulty in furnishing all the energy needed by man for heat or for motion.

It is a fortunate thing that, as the population of the earth increases, man's tastes become more complex. If only the simplest tastes prevailed, only the simplest occupations would be called for. But let us not lose time in idle speculations as to the way this primitive condition of things would affect man's progress. As a matter of fact his tastes are becoming more complex. Things that are not dreamed of in one generation become the necessities of the next generation. Many of these things are the direct results of scientific investigation. No end of examples will suggest themselves. Let me content myself by reference to one that has of late been the subject of much discussion. The development of the artificial dye-stuff industries is extremely instructive in many ways. The development has been the direct result of the scientific investigation of things that seemed to have little, if anything, to do with this world. Many thousands of workmen are now employed, and many millions of dollars are invested, in the manufacture of dye-stuffs that were unknown a few years ago. Here plainly the fundamental fact is the esthetic desire of man for colors. A colorless world would be unbearable to him. Nature accustoms him to color in a great variety of

combinations, and it becomes a necessity to him. And his desires increase as they are gratified. There seems to be no end to development in this line. At all events, the data at our disposal justify the conclusion that there will be a demand for every dye that combines the qualities of beauty and durability. Thousands of scientifically trained men are engaged in work in the effort to discover new dyes to meet the increasing demands. New industries are springing up and many find employment in them. As a rule the increased demand for labor caused by the establishment of these industries is not offset by the closing up of other industries. Certainly it is true that scientific investigation has created large demands for labor that could hardly find employment without these demands.

The welfare of a nation depends to a large extent upon the success of its industries. In his address as president of the British Association for the Advancement of Science given last summer Sir Norman Lockyer quotes Mr. Chamberlain thus: "I do not think it is necessary for me to say anything as to the urgency and necessity of scientific training. * * * It is not too much to say that the existence of this country, as the great commercial nation, depends upon it. * * * It depends very much upon what we are doing now, at the beginning of the twentieth century, whether at its end we shall continue to maintain our supremacy or even equality with our great commercial and manufacturing rivals." In another part of his address Sir Norman Lockyer says: "Further, I am told that the sum of £24,000,000 is less than half the amount by which Germany is yearly enriched by having improved upon our chemical industries, owing to our lack of scientific training. Many other industries have been attacked in the same way since, but taking this one instance alone, if we had spent this money fifty years ago, when the Prince Consort first called attention to our backwardness, the nation would now be much richer than it is, and would have much less to fear from competition."

But enough on the purely material side. Let us turn to the intellectual results of scientific investigation. This part of our subject might be summed up in a few words. It is so obvious that the intellectual condition of mankind is a direct result of scientific investigation that one hesitates to make the statement. The mind of man can not carry him much in advance of his knowledge of the facts. Intellectual gains can be made only by discoveries, and discoveries can be made only by investigation. One generation differs from another in the way it looks at the world. A generation that thinks the earth is the center of the universe differs intellectually from one that has learned the true position of the earth in the solar system, and the general relations of the solar system to other similar systems that make up the universe. A generation that sees in every species of animal and plant evidence of a special creative act differs from one that has recognized the general truth of the conception of evolution. And so in every department of knowledge the great generalizations that have been reached through the persistent efforts of scientific investigators are the intellectual gains that have resulted. These great generalizations measure the intellectual wealth of mankind. They are the foundations of all profitable thought. While the generalizations of science belong to the world, not all the world takes advantage of its opportunities. Nation differs from nation intellectually as individual differs from individual. It is not, however, the possession of knowledge that makes the efficient individual and the efficient nation. It is well known that an individual may be very learned and at the same time very inefficient. The question is, what use does he

make of his knowledge? When we speak of intellectual results of scientific investigation, we mean not only accumulated knowledge, but the way in which this knowledge is invested. A man who simply accumulates money and does not see to it that this money is carefully invested, is a miser, and no large results can come from his efforts. While, then, the intellectual state of a nation is measured partly by the extent to which it has taken possession of the generalizations that belong to the world, it is also measured by the extent to which the methods by which knowledge is accumulated have been brought into requisition and have become a part of the equipment of the people of that nation. The intellectual progress of a nation depends upon the adoption of scientific methods in dealing with intellectual problems. The scientific method is applicable to all kinds of intellectual problems. We need it in every department of activity. I have sometimes wondered what the result would be if the scientific method could be employed in all the manifold problems connected with the management of a government. Questions of tariff, of finance, of international relations would be dealt with much more satisfactorily than at present if the spirit of the scientific method were breathed into those who are called upon to deal with these questions. It is plain, I think, that the higher the intellectual state of a nation the better will it deal with all the problems that present themselves. As the intellectual state is a direct result of scientific investigation, it is clear that the nation that adopts the scientific method will in the end outrank both intellectually and industrially the nation that does not.

What are the ethical results of scientific investigation? No one can tell. There is one thought that in this connection I should like to impress upon you. The fundamental characteristic of the scientific method is honesty. In dealing with any question science asks no favors. The sole object is to learn the truth, and to be guided by the truth. Absolute accuracy, absolute fidelity, absolute honesty are the prime conditions of scientific progress. I believe that the constant use of the scientific method must in the end leave its impress upon him who uses it. The results will not be satisfactory in all cases, but the tendency will be in the right direction. A life spent in accordance with scientific teachings would be of a high order. It would practically conform to the teachings of the highest types of religion. The motives would be different, but so far as conduct is concerned the results would be practically identical. I need not enlarge upon this subject. Unfortunately, abstract truth and knowledge of facts and of the conclusions to be drawn from them do not at present furnish a sufficient basis for right living in the case of the great majority of mankind, and science can not now, and I do not believe it ever can, take the place of religion in some form. When the feeling that the two are antagonistic wears away, as it is wearing away, it will no doubt be seen that one supplements the other, in so far as they have to do with the conduct of man.

What are we doing in this country to encourage scientific investigation? Not until about a quarter of a century ago can it be said that it met with any encouragement. Since then there has been a great change. Up to that time research was sporadic. Soon after it became almost epidemic. The direct cause of the change was the establishing of courses in our universities for the training of investigators somewhat upon the lines followed in the German universities. In these courses the carrying out of an investigation plays an important part. This is, in fact, the culmination of the course. At first there were not many following these courses, but it was not long

before there was a demand for the products. Those who could present evidence that they had followed such courses were generally given the preference. This was especially true in the case of appointments in the colleges, some colleges even going so far as to decline to appoint any one who had not taken the degree of doctor of philosophy, which is the badge of the course that involves investigation. As the demand for those who had received this training increased, the number of those seeking it increased at least in the same proportion. New universities were established and old ones caught the spirit of the new movement until from one end of the country to the other centers of scientific activity are now found, and the amount of research work that is done is enormous compared with what was done twenty-five or thirty years ago. Many of those who get a taste of the work of investigation become fascinated by it and are anxious to devote their lives to it. At present, with the facilities for such work available, it seems probable that most of those who have a strong desire and the necessary industry and ability to follow it find their opportunity somewhere. There is little danger of our losing a genius or even one with fair talent. The world is on the lookout for them. The demand for those who can do good research work is greater than the supply. To be sure the rewards are not as a rule as great as those that are likely to be won by the ablest members of some other professions and occupations, and as long as this condition of affairs continues to exist there will not be as many men of the highest intellectual order engaged in this work as we should like to see. On the other hand, when we consider the great progress that has been made during the last twenty-five years or so, we have every reason to take a cheerful view of the future. If as much progress should be made in the next quarter century, we shall, to say the least, be able to compete with the foremost nations of the world in scientific investigation. In my opinion this progress is largely dependent upon the development of our universities. Without the opportunities for training in the methods of scientific investigation there will be but few investigators. It is necessary to have a large number in order that the principle of selection may operate. In this line of work as in others, many are called, but few are chosen.

Another fact that is working advantageously to increase the amount of scientific research done in this country is the support given by the government in its different scientific bureaus. The Geological Survey, the Department of Agriculture, the Coast and Geodetic Survey, the National Bureau of Standards and other departments are carrying on a large amount of excellent scientific work, and thus helping most efficiently to spread the scientific spirit throughout the land.

Finally, two exceedingly interesting experiments in the way of encouraging scientific investigation are now attracting the attention of the world. I mean, of course, the Carnegie Institution, with its endowment of $10,000,000, and the Rockefeller Institute, devoted to investigations in the field of medicine, which will no doubt be adequately endowed. It is too early to express an opinion in regard to the influence of these great foundations upon the progress of scientific investigation. As both will make possible the carrying out of many investigations that would otherwise probably not be carried out, the chances of achieving valuable results will be increased. The danger is that those who are responsible for the management of the funds will be disappointed that the results are not at once of a striking character, and that they will be tempted to change the method of applying the money

before those who are using it have had a fair chance. But we who are on the outside know little of the plans of those who are inside. All signs indicate that they are making an earnest effort to solve an exceedingly difficult problem, and all who have the opportunity should do everything in their power to aid them.

In the changes which have been brought about in the condition of science in this country since 1848, it is safe to say that this association has either directly or indirectly played a leading part. It is certain that for the labors of scientific men increased facilities and a wider usefulness have been procured.

IRA REMSEN.

*THE TWENTIETH CENTURY BOTANY.**

AT previous meetings of this and kindred societies the retrospective field in botany has been pretty thoroughly covered. It would seem a fitting time, therefore, to take a glance into the future and endeavor to see what there is for botany and botanical science in the years immediately before us. It is realized that an endeavor to set forth the lines along which botany will develop is a risky thing, and no doubt fifty years hence the views I may express at this time will cause only a smile in the light of actual developments. Notwithstanding this fact, I am willing to essay somewhat the rôle of a prophet, not so much with the idea that I expect all of my prophecies to be realized, but rather in recognition of a principle that to wish a thing or to desire a thing is at least a point gained in the full realization of the wish or desire. What I have to say, therefore, will be rather in the nature of an expression as to what I desire to see brought about in a field of work which to me seems fast opening to great possibilities. If an expression of these desires and the vitalizing of the thoughts which inspire them by placing them before you serve but to put in motion some of the forces which will act for the betterment of botany, my object shall have been fulfilled.

Before taking up specifically the more important lines along which botany seems likely to develop, and before considering some of the demands which may be made upon botany in the twentieth century, I should like briefly to call attention to what may be termed the present attitude of the state toward the work, for about this question hinge some points which are of vital importance to the future expansion and growth of botany as a whole. By the attitude of the state I of course mean the attitude of the people, for, in this country at least, the state is the people. It requires no argument to prove that the attitude of the state toward botany is rapidly changing. Even those of the younger generation realize that within their time the feeling of the people toward botany as a science and botany applied has changed greatly for the good of the work. I believe this is due to the fact that the utilitarian side of botany has been kept largely in the foreground, and the people have come to know and understand that a substantial encouragement of the work means a direct benefit to many important interests. When botany and botanical work were confined largely to the collecting and mounting of plants, the building up of herbariums and, perhaps, the working out of obscure laboratory problems, public sentiment could not be aroused in its behalf. Every time we have reached into new fields with the object of broadening the work and benefiting the people, the people have responded and given us most generous aid.

As an object lesson in this field I may call attention to the rapid growth of botany and botanical work in the Department of Agriculture at Washington. Fifteen years

* Address of the past-president, Botanical Society of America, St. Louis meeting, 1903.

ago the total amount expended for work of this kind did not reach $25,000 annually. The present year the honorable secretary's estimates for the work will aggregate about $400,000; and if the allied lines of investigation in which botany and botanical science play an important part are considered, the funds devoted to the work will exceed half a million dollars. This amount, it must be borne in mind, is an annual expenditure and practically represents an endowment on a three-per-cent. basis of over fifteen million dollars. This is for investigations and experiments alone, as purely educational subjects are considered only in an indirect way. That the people, or the state, are not averse to responding to the needs of botany from the educational point of view is manifested in the remarkable development of the work in a number of our important universities and in the growth of educational institutions, a type of which is found in the New York Botanical Garden. Here, through the energy of a corps of earnest workers, the educational value of botany has been recognized and generous support has been secured for the development of gardens, museums and laboratories. These results, however, I imagine, would not have been attained without appealing to the utilitarian ends in view. The practical value of such an institution to the community and to the country has been presented in the proper way, and the necessary support was forthcoming.

The argument, therefore, in all this is that for the future development of botany and botanical work we must make up our minds to two important things; first, the presentation of our wants to those upon whom we must depend for support, in such a way that the ultimate practical value of what we desire to do will be seen; second, the thorough discharge of our duties to the end of showing that the trust imposed on us has been fully and honestly respected. I may be preaching an heretical doctrine and be criticized on the ground that science has nothing to do with such material things and will take care of itself if kept pure and undefiled. This may be true, but I have long since reached the opinion that the doctrine of science for science's sake may be beautiful in theory, but faulty in practice. Some one has said that pure science and science applied are like abstract and practical Christianity, both beautiful, but one is for gods and the other for men.

It is men that we are to deal with in the future—keen, practical, analytical men, and they want and should know the why and the wherefore of what they are asked to support. It is recognized that there are but few men who have the gift of presenting what is frequently an abstruse problem in such a way as to gain material support. There ought to be more such men, and as the needs of the work develop, doubtless there will be more. From the tendency of the times the fact becomes evident that more and more the pursuit of science must be looked upon in a business-like way. Therefore, future aid for this work, be it in botanical or other lines, must come by going after it in the proper manner. In other words, the scientific man can not afford to wrap about himself a mantle of false dignity and assume that because his work is scientific he is debarred from seeking aid where aid is needed. What we shall expect to see, therefore, in the future is a manifestation of that spirit of progress which recognizes that science must seek its own interests and not wait to be sought.

Science, and I mean, of course, in the main, botanical science, can not and will not suffer by this attitude. I do not mean that the spirit of commercialism, of barter and trade, will enter into the matter. This is an extreme which will be avoided, as well as that other which comes with it, the idea that the responsible head of scientific work

must stand on a pinnacle and say, 'I am a scientist; this is enough; walk up and lay at my feet your tributes in order that you may receive my beneficent smiles.' I am not overdrawing this picture, for this very day there are institutions founded and conducted for the advancement of science where this attitude is maintained. The result is that men with the love of their work at heart who are forced to work under these conditions find themselves handicapped on every side by a sort of immaculateness, perhaps beautiful in theory, but of no practical value in the every-day affairs of life. Under this system work is carried to a certain point, and then, when a little effort would make it complete, the dignity—and I use this word with a question mark—of science looms up, and the needed support must give way to that. Fortunately, botany has not suffered so much from this attitude as some of the kindred sciences, but her cause has been delayed by it in certain cases and is being delayed even to-day.

I repeat, therefore, that the twentieth century shall see this spirit disappear, and in its place shall come one which is fully progressive, recognizing that to be a scientist is to be a man of affairs, a man gifted with that most uncommon of all things—common sense. It will be recognized that 'true science is an invention, the invention of a tool, which will enable man to become more vital, more effective, more adequate in the world in which he finds himself.' This is especially true of botanical science, which in the future must necessarily spread into many walks of life.

It is evident from what has been said that botanists themselves will have much to do with shaping the future attitude of the state toward the work in question. Expediency in all cases will govern the action of the state, and the fact that the botany of the future will more and more become closely identified with utilitarian projects will make the state dependent upon it. The rapid changes taking place in population, the filling up of sparsely settled regions, the shifting of general commercial centers, and the unification of commerce in all its branches will bring more and more imperative demands for plants and their products. With these demands will come the necessity for knowing more of such plants, how to use them to the best advantage, and how to increase the possibilities of production so as to meet the demands of the times. These great questions will necessarily force themselves upon the attention of the state through the demands of the people, and the state will on its part require of those charged with this important work investigations which must necessarily be far-reaching in their importance.

The shaping of these lines of work will, as already pointed out, depend in large measure upon the wisdom and farsightedness of botanists themselves. The fact will not be lost sight of that to attain the highest results the true spirit of scientific work must be kept constantly in the foreground. I maintain that this can always be done in such a way as to command the respect and confidence of the scientific world and at the same time secure the practical aid which must necessarily be at hand if anything is to be accomplished at all. So much, therefore, for the probable future attitude of the state toward botany and botanical science. The high place which botany and botanical work have taken in the affairs of nations during the past few years makes it evident that in the years to come this position will not only be maintained, but materially advanced in numerous directions.

And now let us turn to another somewhat general question which it seems to me must necessarily receive careful consideration in the near future, and that is the effect of the present tendency to extreme specialization in botany. No one, I

think, will question the value of a division of labor in science as well as in other pursuits, but the danger comes from carrying this division too far. The specialist is likely to be a dreamer, and a dreamer is dangerous. He is apt to see things of his own creation and not as they actually exist. I have been fortunate in being placed where I could study the specialist, and while I can not help but admire and encourage the patience and persistency with which a special problem is pursued, I am confronted every day with the fact that a concentration of mind on one subject is apt to distort the vision and bring on a sort of neurasthenia, difficult to combat and wholly unaffected by argument. Now there is danger in this sort of thing, not so much where the specialist is surrounded by other specialists, for here each will have a tendency to dehypnotize the other, if I may use such an expression. The difficulty comes where the specialist is necessarily much alone, where he will not be subject to rude awakenings which will come if his work is under the eye of others. Just as the present tendency in political economy is toward a temporary division of labor rather than a permanent division, so it must be with specialization in botany. From all the signs specialization has reached its extreme development, as is evidenced by the fact that we are beginning to realize something of its dangers. In the near future, therefore, we may expect to see a movement toward better unification of the many special lines of botanical work. Rather than division there will be integration where imaginary lines which have been built up will come down and unification will follow.

When we come to consider carefully some of the effects of specialization during the past few years, we are led to the conclusion that it has had more or less of a tendency to cause working botanists to group themselves into castes. Like other castes, these sometimes look upon each other with more or less respect, and again with more or less disdain. In other words, the tendency to concentrate one's effort on a special subject naturally has a tendency to develop more or less egotistical and conceited ideas as to the importance and value of such subjects. Hence, there is produced a sort of aristocracy which prevails more pronouncedly in some cases than in others. For example, the cytologist is pretty apt to look with more or less commiseration on what he considers his less fortunate brother who may be working just outside the range of the plant cell. Then again, the worker who has branched off into some special morphological line, systematic line or physiological line, even though these may be broad branches of botanical science, considers that his particular field is naturally preeminent, and that in handling his problems he must do so without full regard for the consideration of all the questions involved in the other problems. No one can question the fact that specialization has been of great value, particularly during recent years. It has emphasized the importance and necessity for a concentration of energy in one direction. While this is true, experience has shown, as already pointed out, that such concentration necessarily limits one's field of vision, and as a result the true facts, and especially their relationships, can not always be determined. The reaction against this feeling, which is just beginning to be noticeable, is due no doubt to the gradual realization of the fact that all scientific problems are more or less interdependent. We are coming more and more to see that not only are scientific problems in a particular field interdependent, but that all lines of science are closely related, and that to consider them in the most intelligent and far-reaching manner they must be looked upon as part and parcel of one great whole.

Hence, we look to the twentieth century for material changes in this matter of special work and special problems. There will be closer relationships established in the various lines of investigation, not only so far as concerns different phases of botanical work, but other branches of science as well.

Brief reference has already been made to the educational advances which are likely to be made in botany. But these were educational advances of an indirect sort, which naturally arose out of, or in connection with, pure research. Of course all work is educational, but in the sense that we now use the term we mean work that will in the future be conducted in our schools, universities and colleges. In the light of the developments in this field during the past twenty-five years it would seem hazardous to predict what the future is likely to bring forth. Twenty-five years ago the subject of botany in any of our best educational institutions meant primarily teaching in systematic botany. Naturally, the bringing together, grouping and naming of our more or less virgin flora attracted first consideration. Thus systematic botany received an impetus which it maintained for a considerable time. The weakness of the work, however, was to be found in the fact that the problems dealt with had little to do with living subjects. Plants were gathered, named, mounted and placed in herbariums, and the whole question of proper relationships was based on unsound and fallacious reasoning. Naturally, the paramount question here was one of names, and we are still struggling in a maze of doubts and uncertainties which are the direct outcome of our efforts to correct what appeared to be a growing evil.

Perfection, however, is never reached in a leap. Human nature must have experience to guide it, so that we must look upon all that has been done in the past in the matter of systematic work as essential to broader views and broader aims for the future. It is believed, therefore, that systematic botany in the twentieth century will take on new strength as a result of an increasing study of living plants and a better understanding of the manner in which species come into existence. The complicated problem of species relationships will no longer be a matter of more or less guesswork, but will be considered in the light of the results of actual experimentation with the plants themselves.

In this connection the question of meeting some of the requirements for study in this and allied fields will have to be considered. The experience of the old world in the matter of botanic gardens is such as would suggest caution in any attempt to emulate what has been accomplished there. Representative collections of living plants are highly important and valuable, but in bringing them together the fact should not be lost sight of that botany can in the future be advanced by giving more heed to the esthetic side of the work than has been done in the past; that is, assuming that collections of living plants are for study and general educational effect, much of their value in both directions may be lost by adhering too closely to rigid systems. Collections meeting every requirement for study and having great value in a general educational way will probably be maintained in what is more likely to be a natural system. Such collections can, moreover, be maintained at much less expense than the stereotyped ones, and will do much to bring the science of botany home to large numbers of people who can appreciate a bit of lovely landscape, but can see nothing in the little plots and formal labels so suggestive of cemeteries. In other words, it seems to me that the old idea of botanical collections, with small groups of plants representing certain systems of botanical

nomenclature or certain systems of botanical grouping, will give place to natural gardens where may be grouped herbaceous, shrubby and other plants in such a way as to appeal to the mind through the eye. Unquestionably a much greater appreciation of botany and botanical work can be brought about by gardens of this kind, and it is believed that great encouragement will be made in the matter of their development at educational institutions wherever opportunity affords.

In morphology and physiology we shall expect to see more and more important problems worked out by experimental methods. Less attention will be given to the mere accumulation of facts without proper coordination. The value and importance of experimental morphology are already beginning to be realized; that is, experimental morphology from the standpoint of work on plants in their natural environment rather than under laboratory conditions. The same is true of physiology. In the past our knowledge of plant physiology has been largely based on laboratory work and studies of one or more individual plants. From such data broad generalizations have been made, which, as time has shown, have in many cases been erroneous. In other words, it has been found unsafe and unreliable to base generalizations in the matter of the life processes of plants on laboratory experiments alone. The physiology of the future will undoubtedly pay more heed to the broader questions of plant life in their relation to environment and their adaptation in general to surrounding conditions. In other words, ecology in its broad sense is to be an important factor in the future study of plants. In the past we have had a school of scientific workers arise and endeavor to demonstrate that the growth of plants is controlled in large measure by the chemical properties of the soil. More recently another school has developed in which the physical properties of the soil are pointed out as the chief factors in influencing life processes. Those who study plants themselves can not accept such generalities. It is not safe. Future ecological studies will undoubtedly furnish much new light on the true relationships existing between plants and their environment. These questions must naturally receive a great deal of attention for the reason that many of the most important problems in agriculture, horticulture and forestry will be based upon them.

It is in pathology that we shall expect to see very important advances within the near future. This science is just on the threshold of its development. From the purely utilitarian standpoint it will be of vital consequence, and everything in the nature of strengthening it will necessarily need to receive most careful thought. The pathology of the future will have its groundwork in physiology. Less and less attention will undoubtedly be given to the mere question of remedial measures, and more thought will be paid to the causes of plant diseases and the relation of environment to these causes. The highest type of pathological work, in other words, will be in the field of preventive measures, either by the correction of unfavorable conditions or by developing plants in such a way that they can meet conditions which are not favorable.

In the light of these probable developments, an important question to consider is: Where are the workers to come from and how are they to be trained? Undoubtedly in the future much greater interest will be taken in botanical work in our educational institutions, for the reason that it is gradually coming to the knowledge of young men that there is a demand for persons well trained in plant lines. As a matter of fact, during the last few years the supply of

such men has not been equal to the demand. The reason for this is not far to seek, for there still exists in the minds of most young men who go to college an idea that their future welfare in large measure depends on taking some academic course. It seems important and necessary, therefore, that botanists should put forth their best efforts to bring about a better appreciation of the advantages to be gained in the field of botanical work. A number of colleges and universities already have courses of study which pretty well equip graduates for the advanced work in botany now required. In the future there will be more, and at the same time there will be a greater encouragement for applied work than there is at present. In most colleges it is not practicable at the present time to give men the necessary training for government work. A few years ago this was different, for at that time a graduate from one of our best universities was able at once to meet the general requirements of government investigations. The government requirements, however, have been broadened, so that men capable of handling the problems which now present themselves must necessarily have some preliminary experience with men and affairs before they are in a position to take up independent problems. With a good foundation training in botanical science, especially plant physiology and pathology, a good training in languages and a proper appreciation of the relation of science to practice, men can soon get a sufficient grasp of broad problems to make themselves exceedingly valuable. Those who from temperament or for other reasons are interested only in pure science must necessarily have their field of work limited. For this reason it is believed that in the future colleges will more and more endeavor to emphasize the value and importance of applied work.

After reviewing, necessarily with more or less haste, these various questions as to the probable future development of botany, I have left for the last the question which seems to be of primary importance, for upon a proper appreciation of it will depend much of the success of whatever is undertaken in botanical lines during the years to come. I refer to the necessity for properly organizing the botanical forces which not only exist now, but which are likely to come into existence as the years go by. We have developed in this country a group of botanical organizations, all of which are doing good work and most of which have arisen largely out of the exigencies of the moment. There has as yet been little attempt toward a proper coordination of these various forces, with the object of bringing about unity of action upon all matters which will be for the best interest of botany and botanical work in the broadest sense of the word.

This society was organized primarily to take the lead in botanical work in America. Its standards are high and should be maintained. Criticism, if criticism may be offered, of the work of the society, is that it has so far not developed the individuality that might have been developed, in the light of the questions which were in mind at the time of its organization. The papers which are offered do not differ materially from those presented by other societies and organizations. To my mind it has not been so much a question of the presentation of papers as some would think. Unless the papers presented can be in some way made different from those offered in other organizations, there is little to be gained by presenting them except affording an opportunity for those who wish to bring their problems before coworkers. It would seem to me that this society might very well dispense with a considerable portion of this plan, and devote its energies more in the future to broad questions of shaping policy

in botanical work generally throughout the country. To accomplish this, it is realized that the aid and cooperation of all other botanical societies should be secured. No question is raised as to the value and necessity of other botanical organizations. We do not believe that there are too many of them, but that there is a woeful lack of proper unification and coordination was shown at the last Washington meeting, where the number of papers presented was so great that it was impossible for visiting botanists to take anything like advantage of them. In the future it is hoped and believed that existing botanical organizations can be continued and their integrity and independence maintained, but at the same time it would seem highly important that some steps be taken toward unification. There would seem no reason why the Botanical Society of America should not be the medium for bringing this about, and why, through its efforts, there should not be effected an organization representing the various botanical societies throughout the country which would affiliate with this society and assist in shaping a general policy on all matters affecting the welfare of the science.

The time seems ripe for bringing about this result. Never was botany more prosperous, never more aggressive. On the threshold of the twentieth century we stand, knowing our strength and only needing to weld it into harmonious action to make it vital and lasting. Let us join hands and do our best to bring this about.

Beverly T. Galloway.

## *VITALISM AND MECHANISM IN BIOLOGY AND MEDICINE.**

Until some sixty years ago the prevalent view was that nearly all life phenomena were guided essentially by an all-pervading vital force. Even after the discovery by Wöhler in 1828 of the possibility of producing synthetically such an organic substance as urea, such a universal mind as that of Johannes Müller was still clinging to the belief in the all-powerful force as the creator and harmonizer of the various mechanisms of the living body. The belief in the omnipresence of an all-creating vital force furnished little stimulus for laborious studies of the innumerable mechanisms of life. In the forties of the last century, however, there came a change. With the improvement of the methods of investigation, with the rapid progress in organic chemistry, with the establishment of the law of conservation of energy in physics, with the successful application of physical and chemical laws to some of the intricate problems of life, the conviction developed that a great many of the mysteries of life will resolve themselves into physics and chemistry, and this belief gradually grew in some quarters into a theory that all life phenomena are nothing else but complex phenomena of the inorganic world. As just in those days it was recognized in physics that all energies can be converted into motion, and that the mechanical energy is the essential principle in the inorganic world, the new theory which made no distinction between the animate and inanimate phenomena became known as the mechanical theory of life. Right or wrong, this theory was of incalculable benefit to the progress of the biological sciences. The conviction that all parts of life are accessible to an analysis by the methods employed in natural science, stimulated then and stimulates now thousands of patient investigators in their indefatigable attempts to unravel an infinitely small fraction of the mysteries of life. Vitalism had a paralyzing effect. The mechanical conception of the life phenomena

* Introductory remarks made at the D. W. Harrington lectures on 'Œdema, a Consideration of the Physiological and Pathological Factors Concerned in its Formation,' delivered at the University of Buffalo, November 30, December 1, 2 and 3, 1903.

as a working hypothesis is a marvelous stimulus. But it did not remain a working hypothesis.

Men of letters with a transcendental bent of mind have turned it soon into a philosophical system and have extended it to regions which can never become the domain of natural science. Some of the extravagances proclaimed in the name of the mechanical theory brought undeserved discredit upon it. I need only to remind you of the statement that ideas are secreted by the nerve cells just as urine is secreted by the kidney epithelium. Assertions of this kind initiated a reaction against the entire theory. The theory of natural selection by Darwin, which, during its rise, lent its glory to our theory, since in the minds of the literary public the two were naturally linked together, subsequently also brought some discredit to it during its slow descent in the favor of that public. Furthermore, the very incessant activity in the investigation of biological problems which was stimulated by the mechanical theory soon brought out the unmistakable fact that, so far, comparatively only a small fraction of life phenomena are accessible to interpretation by the physics and chemistry of our day, and the enthusiastic originators of the mechanical theory have inadvertently proclaimed that the physics and chemistry of their day would explain all life phenomena. What a failure! say now the growing number of vitalists, or 'neo vitalists,' as they choose to call themselves. Since the middle of the eighties of the last century a reaction set in against the mechanical theory. In all branches of biology an increasing number of writers of first standing are coming out, veiled or open, against the mechanical theory of life. We meet them in physiological chemistry, in general biology, and we meet them in the writings on medicine, the science as well as the practice of medicine. We meet them in the writings on the very subjects I am going to discuss before you, on the subjects of the production of lymph and formation of œdema. And withal the vitalism of our day is not such a modest or conservative creation as the prefix 'neo' would lead us to believe. For instance, because only certain substances are absorbed within the intestines, a selection that can not be explained by the laws of diffusion and osmosis as we know them to-day, it is assumed by some writers that the epithelium of the intestinal mucosa has a selective power. But, instead of considering this assumption merely as a temporary resting place, until we know something more of physics and chemistry, the conclusion is drawn by Neumeister, a distinguished physiological chemist, that the epithelium possesses as much sensation, as much judicial power to know what is good for the body, as the nerve cells of the cortex. In what essential respect does this statement differ from the one of Carl Vogt, which was quoted above and which had such a shocking effect upon his contemporaries, namely, that there is not one difference between the nerve cells which secrete ideas and the kidney epithelium which excretes urine?

The point is that Vogt as well as Neumeister, though both excellent scientists, have not made their assertions as naturalists but as philosophers, who are dealing with transcendental problems. The discussion which is going on between the vitalists and mechanists and which has not only a theoretical but also a very important practical bearing upon many problems in biology and medicine, suffers, in my opinion, from a confusion of conceptions with regard to the questions to be answered. Permit me to discuss here the problems of vitalism and mechanism from my own point of view.

The phenomena of life are apparently different from those of the inorganic world.

We wish to recognize as much of them as our human faculties will permit, and wish to study them by methods of investigation which proved to be reliable in the investigations of the phenomena of the inorganic world. Then there are some preliminary questions to be answered.

TRANSCENDENTAL VITALISM AND MECHANISM.

The first question is: Suppose there will come a time when all laws of the inorganic world and also all structures and laws of the animated world, as far as they are accessible to the human faculties, will be completely known—will it then be found that the phenomena of life can be completely solved, or will it be found that life has still an element which is inconceivable, inaccessible to the grasp of human faculties. This is the concise question between mechanism and vitalism. What should be our position with regard to that question? To this I say it is wholly a transcendental question and not one for physiology and biology to deal with. Since from the point of view of the natural or rather biological sciences we wish to investigate only that which is accessible to human faculties and by methods approved in the natural sciences, we can obviously have no scientific opinions on a subject which is admittedly above the human faculties. An answer in the mechanistic sense is not a whit more scientific than an answer in favor of vitalism would be.

This position, however, should not be interpreted as denying the right to entertain such a question. It is certainly a perfectly legitimate problem in pure philosophy. Neither do I mean to deny the naturalist the right to discuss philosophical problems. But in such a case the discussion in both domains ought to be carried on strictly separately, otherwise, as experience teaches us, a harmful confusion will be unavoidable.

To repeat again, we consider the problem formulated in the preceding question as a transcendental one, and we shall, therefore, designate the theories contained in the answers to it as transcendental vitalism or transcendental mechanism.

NATURAL VITALISM AND MECHANISM.

The second question is: Suppose there shall come a time when all laws of the inorganic world as well as the structures and laws of the animated world shall be perfectly known to us. Would it then be found that the animated world is governed exactly by the same laws as the inanimate one, *i. e.*, by the laws of physics and chemistry, as they will then be known; or will it be found that the vital phenomena, in addition to the chemicophysical forces, are pervaded by separate energies, separate forces which are specific for living matter? It must be admitted that this question is a perfectly legitimate one and within the bounds of natural science. It is perfectly conceivable that one group of natural phenomena might possess energies which other groups do not possess and that vital phenomena might differ, indeed, from the phenomena of the inorganic world by a plus of specific energies. In contradistinction to the transcendental theories of life we might designate the theories contained in the answers to the second question as natural mechanism and natural vitalism. In other words, then, the theory of natural mechanism assumes that all the conceivable laws of life will prove to be nothing but physics and chemistry, and the theory of natural vitalism assumes that all vital phenomena are directed by specific energies besides those which are found also in the physical world. A little consideration will show that the natural and transcendental theories are perfectly independent of one another. For instance, the transcendental vitalist can easily accept the

theory of natural mechanism, and the defender of the theory of natural vitalism may accept the theory of transcendental mechanism. I shall, however, certainly not dwell here on the particulars of this point.

What shall be our position with regard to the problem involved in the second question? It seems to me that the state of our present knowledge does not permit us yet to decide the question in one way or another with any degree of probability, and that for a great many years to come any decision of this problem will have to be considered as an arbitrary hypothesis without a sufficient scientific basis. The argument in favor of vitalism, brought forward recently by Bunge, Neumeister, Stacke, Kassowitz and many others, consists in the statement that the further the investigation in biology progresses, the more facts are brought to light which can not be explained by physics and chemistry. But what does this signify? Our present knowledge of physics and chemistry surely is a most minute fraction of that which we shall know of the laws of the inorganic world in the thousands of years to come. Considering the length of human history we have to admit that even the science of physics is only in its very infancy. Why, it is only recently that they have tortured the father of physics for stating that the earth is turning around the sun, because it hurt their feelings to acknowledge that the abode of man is not the center of the universe. And it hurts the feelings of men to be told that the mysteries of life are only unrecognized chemistry—hence the passionate crusade in some circles against mechanism in biology. In our very day undreamt of discoveries are made in physics and in chemistry. Think of the rays discovered by Roentgen which penetrate heart and kidneys. Think of the marvelous results of stereochemistry, of the laws of osmosis, of the ionization of solutions, etc., all discoveries of our time. Why should we already now positively deny the possibility that chemistry and physics might not finally elucidate a great many, and perhaps all the facts in biology? Furthermore, the attempts properly and systematically to apply physics and chemistry to the interpretation of biological phenomena are hardly older than half a century. Those among the crusaders who themselves lent a hand to such studies should know with what immense difficulties the physiologist has to struggle. He has to create his own physics and chemistry; he has to master a difficult and difficile technique, and then the difficulties in obtaining and handling living material. The physicist and the chemist had always the aid of gold-seeking people. There is no gold for physiology, but plenty of obstruction on its onward way, placed by the sentimentalist, the ignorant and the wicked. With all the obstacles, physiology has already succeeded, in a great measure, to apply physics and chemistry to a good many biological phenomena, and the outlook for the future is brighter than ever. Think of the astonishing discovery in our country by Jacques Loeb of artificial parthenogenesis by simple changes in the osmotic pressure in the surrounding medium of the ovum, a fact which was never dreamt of before!

No, the crusaders against mechanism are wrong in their pessimistic views. There is nothing in the present stage of our knowledge discouraging for the hopes of those who believe in the ultimate solution of the problems of vital phenomena by the physics and chemistry of a far-off future. But it is also true that the success attained at present is, in comparison with what has yet to be attained, too minute, too insignificant to justify a prediction with any degree of probability.

Transcendental mechanism and vitalism

have no place within the domain of natural science. Natural mechanism and vitalism are insufficiently supported by accumulated evidence to be considered as well-established scientific theories.

VITALISM AS A WORKING HYPOTHESIS.

But there is still another question. There are already numerous well-established biological facts which can not be explained for the present by physics and chemistry, and we have no means of knowing whether they will ever be explained that way—what are we to do with these facts? Here is the answer: Vitalism as a storage place is indispensable. We should continue to call these facts vital phenomena until we discover a way to explain them by laws governing the inanimate bodies. But I shall still go further. I believe that vitalism as a working hypothesis is of great advantage to the progress of biology. The belief that only those biological facts which can be reduced to physics and chemistry can be considered as scientifically understood, combined with the misleading and harmful notion to elevate physiology to an exact science, confined the activity of this biologic division to some favored domains—to its own detriment. The sterility of some parts of physiology is due to this inappropriate exclusiveness. The relation of the internal secretion of the thyroid to myxœdema and cretinism and of the pancreas to diabetes, was discovered without any reference to physics and chemistry and was discovered by medical men, and not by physiologists. The important fact of the marvelous effect of the extract of the suprarenal capsule upon the circulation was discovered by physiologists without any reference to physics and chemistry. Surely physiology ought to search for the physics and chemistry of the vital processes as much as possible, but it ought to do more. It ought to unearth vital phenomena, study their characters by methods peculiar to themselves, and establish their laws aside from any relation to physics and chemistry of the inorganic world. That this can be successfully done is shown by the marvelous results obtained in the discoveries and the precise studies of toxines, antitoxines, hæmolysines, cytolysines and their like without much regard for physics and chemistry. Especially medical men have reason to ask for such physiological studies. The experiments which nature is continually making upon human beings and which physicians are called upon to interpret and to mend are not confined to domains which are accessible to interpretations by physics and chemistry. And it is to such a far-seeing, liberal, broad physiology that the science and practice of medicine is looking for a delivery from the firm grasp of the one-sided teachings of pathological anatomy.

S. J. Melzer.

## SCIENTIFIC BOOKS.

*Mammalian Anatomy, with special reference to the Cat.* By Alvin Davison, Ph.D. Philadelphia, P. Blakiston's Son & Co. 1903. 8vo. Pp. xi + 250; 108 figs.

Another book on the anatomy of the cat can not but awaken suspicion as to its utility, but an examination of this one shows the suspicion to be unfounded. It is designed to fill the gap between the more detailed works and those which are merely laboratory guides, and to afford the student who can not pursue a lengthy course of zoological study, a general idea of the structure of a mammal and of the principles of mammalian anatomy.

In writing such a work the important point is to determine what is to be omitted, and Professor Davison has treated his subject with an admirable perspective. Occasionally, as in the description of the peritoneum, a somewhat fuller development of the subject would have been advisable, and occasionally, also, a brevity of statement tends to convey a somewhat erroneous impression. But such errors

are few and the book furnishes an excellent idea of the structure of the cat, free from a superfluity of detail which too often serves merely to conceal from the young student the fundamental principles which they may be intended to elucidate. Profusion of detail does not always make for accuracy in the student and it is principles rather than facts that he should acquire from his laboratory training.

Throughout the book are frequent remarks of a comparative nature and at the close of each chapter is a list of questions or suggestions, for the most part of a general nature, which will serve as excellent topics for comment by the teacher or for collateral investigation under his direction by the student. An introductory chapter is devoted to an account of useful methods by which the dissection of a mammal may be facilitated, and the text is illustrated by numerous figures and diagrams for the most part admirably executed.

J. P. McM.

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## *SOCIETIES AND ACADEMIES.*

### PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 573d meeting was held November 7. Dr. A. L. Day spoke on 'The Black Body and the Measurement of Extreme Temperatures.' He outlined the history of the theoretical study of the problem, and showed how such a body had been constructed artificially; he then discussed at length the results of experiments made with it, pointing out the relation between the temperature and the total radiation, and between the temperature and the wave-length of radiation of maximum intensity, and expressing these relations by equations; from these equations temperatures outside the range of measurement can be calculated by extrapolation.

Mr. C. E. Van Orstrand followed with 'Notes on the Emission Function,' discussing mathematically the second of the equations presented by the preceding speaker.

AT the 574th meeting, held November 21, the subject of 'Synchronous Actions in the Atmospheres of the Sun and the Earth' was discussed by Professor F. H. Bigelow, of the Weather Bureau. The curves first published in 1894, showing simultaneous variations in the sunspot areas, the magnetic field, the pressures and temperatures of the northwestern states, the movements in latitude and longitudes of the storm centers, were compared with the prominence secular variations and found to agree. The meteorological data have been extended to all parts of the earth and they give similar variations, supplemented by inversion of the type. Thus the direct type of temperature prevails throughout the tropics, and the inverse type in the temperate zones; the direct type of pressures holds around the Indian Ocean and the inverse type in North and South America. The distribution of the prominences in latitude and their movements in the eleven-year cycle were explained, also their distribution in longitude. From the latter were derived the periods of rotation of the sun in different zones, and the variations of the several periods in the eleven-year cycle, which gave the same curve as holds for the prominence frequency. This important phenomenon was referred back to the internal circulation of the sun, and it confirms the second case of von Helmholtz's equations, as applied to a rotating mass heated at the center. The fundamental period of the sun's rotation is that of the equator, 26.68 days, and as this is the shortest possible period in the sun it follows that numerous determinations of the solar rotation from terrestrial phenomena, such as aurora, thunderstorms, must be excluded as misleading. The observed synchronism at the earth has its basis in the sun's circulation, and this is of a kind to produce vertical polarization, and an internal magnetic field. Hence all stars should be magnetized while the process of cooling under their own gravitation is going on.

Mr. L. A. Bauer then presented several brief 'Contributions to the Theory of the Earth's Permanent Magnetism.' He showed that the energy of the earth's magnetization had diminished by one thirty-sixth part in forty-six years. He stated as a result of his analysis that the principal cause of secular variation resides outside the earth's crust. He also attempted a calculation of the magnetic en-

ergy per unit of area at the surface of the earth.

The 575th meeting on December 5 was set apart for the annual address of the retiring president, Professor James Howard Gore. His subject was 'The Geoidal Figure of the Earth.' He pointed out that four views had been held successively regarding the form of the earth—that it was a plane, a sphere, a spheroid, and a geoid; he traced the history of the measurements that had led to the successive views, and discussed at length the present conclusions of geodesists.

Charles K. Wead,
*Secretary.*

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 146th meeting held on November 25, 1903, the following papers were presented:

*Ninth Session of the International Congress of Geologists, at Vienna:* S. F. Emmons.

*The Alaska-Treadwell Mine:* A. C. Spencer.

*The Stratigraphic Position of the Judith River Beds:* T. W. Stanton and J. B. Hatchel.

The above papers have been or shortly will be published in full.

The 147th meeting of the society was held on December 9. Under the title 'Notes on the Deposition of the Appalachian Pottsville,' Mr. David White presented certain conclusions respecting the physical geography of the Aplachian trough during early Pennsylvanian time, with correlations based largely on the study of the fossil plants. These show the existence in lower Pottsville time of an axial trough near the eastern margin of the present coal region. The loading and subsidence of this relatively narrow trough led to the submergence of the western land, and in late Pottsville time the transgression of the sea across the bituminous regions of Pennsylvania, Ohio, western Maryland and northern West Virginia. The thickness of the Pottsville sediments, about 1,200 feet in the type section, was shown to be about 4,000 feet near the eastern border, in southwest Virginia near the Tennessee line.

Dr. George H. Girty made a comparison of sections of upper Paleozoic rocks in Ohio and northwestern Pennsylvania. He showed that not the Shenango sandstone, as had usually been supposed, but a much lower bed in the Crawford County section, was equivalent to the sub-Olean conglomerate. This was determined by tracing eastward from its typical locality the Corry sandstone, which near Warren was found to occupy a position just above the sub-Olean. The latter, therefore, would appear to occur at about the horizon of the Berea grit of Ohio, which is the same as the Cussewago sandstone, which lies not far below the Corry sandstone in Professor I. C. White's section of Crawford and Erie counties.

The Waverly group of Ohio was explicitly included by Meek and Worthen, along with the Chouteau group of Missouri and the Goniatite limestone of Rockford, Indiana, in their definition of the Kinderhook group or epoch. The only Waverly fauna well known at that time was the fauna of the Cuyahoga shale, and these authors seem to have had in mind as the Kinderhook fauna chiefly that of the Chouteau limestone. If any precise correlation is possible between the Waverly group and the early Mississippian of the Mississippi valley, it lies between the middle member of the Cuyahoga formation and the Chouteau limestone. It follows, therefore, that the series of rocks and faunas in southwestern New York which overlie the true Chemung, inclusive of the sub-Olean conglomerate, recently assigned by Professor J. M. Clarke to the Carboniferous, really lie below the base of the Carboniferous system as at present recognized in this country, just as they lie above the Chemung beds, the recognized top of the Devonian. This series, having an approximate thickness of 500 feet, represents an interval not provided for in the geological time-scale, and for it the term Bradfordian is proposed. This term, which will rank with Senecan, Chautauquan, etc., includes the Cattaraugus, Oswayo and Knapp beds of the New York section, which may provisionally be accepted as its subdivisions. The position of this series as an unrecognized interval in the time-scale is quite apart from the determination of its age as Devonian or Carboniferous,

a question which is reserved for further study and discussion. The Bradfordian faunas are equally distinct from those of the Chemung group, on one hand, and from those of the Waverly group, on the other. They contain to some extent an intermingling of Carboniferous and Devonian species, and are in fact transitional between those of the two eras corresponding to the position of the rocks in which they are found.

A recent bulletin of the U. S. Geological Survey, by Professor H. S. Williams, which deals with the migrations of faunas, so far as it involves the rocks and faunas under consideration, is based upon a misconception of their stratigraphic relations.

This was followed by a paper entitled 'Fluorspar Deposits of Southern Illinois,' by Dr. H. Foster Bain.

These deposits occur within an elliptical area about forty miles in diameter covering positions of southern Illinois and the adjacent part of Kentucky, and forming a truncated dome probably reduced to a peneplain in Tertiary time. The region is one of the normal faulting and the individual blocks of strata are very irregularly disposed. The ore occurs in fissure veins along these fault planes. In the region are a number of dikes of mica-peridotite, biotite-pyroxenite and diabase. The type of deposits, unusual in the Mississippi valley, associated with the igneous rocks suggests a genetic relation and the analogy with the fluorspar deposits of the northern England is very close.

THE 148th regular and 11th annual meeting of the society took place on December 10. The first part of the meeting was occupied by the presidential address of Dr. C. Willard Hayes, entitled 'Should There be a Federal Department of Mines.' Later the reports of the secretaries and treasurers were presented followed by the election of officers for the ensuing year.

*President*—C. Willard Hayes.

*Vice-Presidents*—George P. Merrill and Waldemar Lindgren.

*Secretaries*—Walter C. Mendenhall and Alfred H. Brooks.

*Treasurer*—George W. Store.

*Members of Council at Large*—David White, T. W. Stanton, T. Wayland Vaughan, M. R. Campbell and Leslie F. Ransom.

ALFRED H. BROOKS,
*Secretary.*

CHEMICAL SOCIETY OF WASHINGTON.

THE 144th regular meeting of the Washington Chemical Society was held on October 8, at 8 P.M., in the assembly hall of the Cosmos Club. In the absence of the president, the meeting was called to order by the vice-president, Dr. E. T. Allen.

The program for the evening consisted of two papers. The first paper, entitled 'Second Report on Cement Analysis,' was presented by Dr. W. F. Hillebrand and dealt with the results of the analyses of two samples of cement material, which were made by nineteen chemists working independently. The results obtained by these chemists were compared with a standard analysis made by Dr. Hillebrand and many of the determinations differed very markedly from the standard results. A discussion of these variations was entered into by the author, and it was pointed out that, although many differences existed among the determinations made by the various analysts, it was not necessary to assume that the source of the errors lay with the method, but was due to other factors which must be taken into consideration.

The second paper on the program was presented by Dr. Atherton Seidell, and was entitled 'Precipitation of Zinc by Manganese Peroxide, with especial reference to the Volhard Method of Determining Manganese.' The problem involved and the method used for the analysis of the precipitate formed in the Volhard method for the determination of manganese were briefly described. The results of the investigation lead to the conclusion that zinc is always carried down by the precipitated peroxide of manganese. The amount found in the precipitate depends upon the quantity which is present in the solution at the time the precipitation is made.

The ratio between the zinc oxide and the manganese peroxide found in the precipitates indicates the formation of mixtures having definite molecular ratios.

The precipitate having the composition $4MnO_2.ZnO$ contained the highest relative amount of zinc which could be carried down in combination with manganese peroxide. The water of hydration in the precipitates was found to be variable, and its amount at any of the temperatures selected for drying did not correspond to a whole number of molecules.

The 145th regular meeting of the Washington Chemical Society was held November 12 in the assembly room of the Cosmos Club. Dr. H. N. Stokes and Mr. S. S. Voorhees were elected councillors of the American Chemical Society. Dr. Atherton Seidell was elected secretary of the Washington Chemical Society. The first paper on the program, entitled 'European Notes,' was delivered by Professor F. W. Clarke. The speaker described his recent visit to Manchester, England, in attendance upon the meeting held in honor of the one hundredth anniversary of Dalton's discovery. He also told of his visits to Cambridge and the laboratories of Thorpe and Ramsay in London, to a meeting of the Royal Society and the Royal Society Social Club. A short account of the meeting of the Congress of Applied Chemistry held at Berlin was given, after which he described his subsequent visits to Dresden, then to Munich, where he was shown Beyer's laboratory built by Liebig and also made acquainted with the great work in mineralogy which is now being done by Groth. Dr. Clarke also spoke of his visits to Zurich and to Heidelberg. The second paper, entitled 'The Solubility of Calcium Sulphate in Aqueous Solutions of Sulphuric Acid,' by F. K. Cameron and J. F. Breazeale, was presented by Dr. Cameron. The authors showed that in the presence of any concentration of sulphuric acid the solubility curve for gypsum or calcium sulphate did not show a maximum point, as this substance does in pure water, but increases steadily with increase in temperature. At temperatures from 25° C. to 85° C. the solubility of calcium sulphate increases with increasing concentration of sulphuric acid until a maximum is reached and then decreases again. The position of the maximum point on the curve, the concentration with respect to calcium sulphate and sulphuric acid respectively being taken as ordinates, depends upon the temperature. The data obtained seems to negative the assumption that both electrolytes yield a common ion. These hypotheses suggest themselves:

1. That at higher dilutions sulphuric acid yields mainly an $HSO_4$ ion and with increasing concentration mainly an $SO_4$ ion. But this assumption is opposed to the results of previous work of others on the conductivity, etc., of solutions of sulphuric acid.

2. That double or bisulphates are formed. An examination of the solid phase in contact with the solution failed to throw light upon this point.

3. That other solubility effects than that occasioned by the ions masked the action of the latter.

No satisfactory criteria exist by which these assumptions may be adequately tested. The authors do not regard the facts as necessarily opposed to the dissociation hypothesis. But the hypothesis in its present form is unsatisfactory and inadequate to furnish assistance in the study of such phenomena.

It was pointed out that in these solutions there was evidence of a condensation of the solvent, water, which might have an important bearing on the apparently abnormal results. Finally, the solubility of calcium sulphate in pure water was discussed in comparison with the results obtained by other investigators.

A. Seidell,
*Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 377th meeting was held Saturday evening, November 28.

H. F. Moore spoke on 'The Artificial Fattening of Oysters,' stating that experiments made by the U. S. Fish Commission showed that when placed in artificial ponds, kept at the right degree of temperature and salinity to foster the growth of diatoms, and with the water kept in motion to imitate the movement of the tide, poor oysters rapidly became fat.

F. H. Hillman described 'The Comparative Effects of the Seed Midge and of *Bruchophagus funebris* on the Structure of Clover Flowers and Fruits.' The speaker stated that

the seed midge, *Cecidomyia leguminicola* Lintner, arrested the growth of the clover corolla, usually causing it to project but slightly from the throat of the calyx, while its base became crustaceous, forming a hardened case about the growing larva. At the same time the pistil became aborted, its growth being arrested before fertilization, while, together with the stamens, it was pushed aside by the growing larva. The attacks of *Bruchophagus funebris* (Howard) does not prevent the complete or nearly complete development of the corolla, which, in this case, does not become crustaceous. The ovary becomes nearly mature, its hardened portion being fully formed. The seed attains nearly full size, but instead of being normally violet or yellow, plump and shining, it is brown, dull and somewhat shrunken. The kernel of the seed is practically exhausted, leaving the seed coat as a frail shell.

These essential differences in the life histories of the insects shown in their effects on the clover flowers and fruits appear to afford conclusive evidence of the correctness of Professor Hopkins's opinion that *Bruchophagus funebris* feeds on the clover seed and is not parasitic on the seed midge, as has been believed.

An examination by the author of 32 red clover heads showed 53 per cent. of the seed farmed to be uninjured, while 47 per cent. was destroyed by the *Bruchophagus*.

Enlarged figures showing the structures discussed were displayed.

Charles Hallock spoke on the subject of 'Sea Trout where no Rivers Are,' the object of the communication being to establish the point that the sea trout is not a fresh-water species with marine habits, but primarily a resident of salt water. It was stated that the sea trout of the Shetland Islands and the Labrador coast, which attain a weight of twenty pounds, do not enter rivers to spawn, nor do more than a moiety of the Canadian sea trout, the bulk of these spawning in estuaries in tide water. While these trout were structurally identical with the fresh-water species, they differed widely from the latter in habits, range, food and appearance, and the speaker considered that these facts should be allowed due weight in differentiating between species. In the course of his remarks Mr. Hallock intimated that the salmon of the Atlantic coast passed the salt-water portion of their life in the subarctic belt, being attracted thither by the abundance of coastwise food.

The fourth paper of the evening, entitled 'The Vegetative Vigor of Hybrids and Mutations,' was read by Mr. O. F. Cook. Hybrids and mutations were interpreted as representing opposite side-paths of the evolutionary thoroughfare, the free interbreeding of numerous moderately diverse individuals being the best condition for evolutionary progress. A declining reproductive power characterizes both of these extreme types of variation, but is often accompanied by unusual vegetative vigor. Physiological and selective explanations of this paradox appear to be inadequate, but from the standpoint of a kinetic theory of evolution it was suggested that the vigor is the same as that of normal variations and crosses, while the relative or complete sterility may be due in both cases to the absence of normal interbreeding, which also induces abrupt variations or aberrations of heredity. Vegetative vigor does not, therefore, conflict with the view that hybrids and mutations are degenerative variations.

F. A. Lucas.

### ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 349th meeting was held on November 3, 1903.

Professor W J McGee gave an account of the work performed by the American Anthropological Association at the recent meeting held in New York and also gave a résumé of the work of the Department of Anthropology of the World's Fair at St. Louis.

Mr. Goddard, of the University of California, was present and was invited to address the society. He told of the investigations being carried on in the language, folk-lore and ceremonials of the Indians of California by the Ethnological and Archeological Survey of the state. He spoke of the extinction of stocks and the decay of customs and urged the aid of students before it is too late.

Dr. John R. Swanton gave a communication

on the Haida and other tribes he has been studying. In his winter field work he hopes to ascertain the relationships, if any, between the Tlinkit and the Haida.

On account of the illness of Dr. Lamb his paper went over, and the society resolved itself into a committee of the whole to discuss the subject of cave exploration.

Professor Holmes stated the problems to be solved and mentioned the explorations of Fowke, McGuire, Putnam and Moorehead. He pointed out that caves show undisturbed sites and hence give a good record, and announced that Professor Putnam has found early man with fossils in caves of California. As yet he said the evidence of early man in the caves exploration in the east is negative.

Dr. Fewkes said that caves were gathering places of men for religious purposes as the Cave of the Sun at Porto Plata, where it is believed by the natives that the sun and moon rose. He stated his belief that the lowest form of man is found in South America and in caves in the region of the Tapuyan stock. Dr. Hrdlicka remarked on the caves of northern Mexico where there are (1) shelters showing evidences of fire, chips and bones, and little art; (2) having human burial; (3) the deep variety containing ceremonial objects, and (4) the dwelling caves, and showed all occur in a region inhabited by a single people.

Mr. McGuire gave an interesting account of his recent cave hunting in Maryland and Pennsylvania. He examined a number of caves, and while the finds were numerous no evidence was found as to the antiquity of man.

Professor McGee said that cave studies should be made not so much for man as for paleontology, and should be a geological problem.

The president told interestingly her observations on cave exploration and said that some Indian words indicate going under the ground to enter the house, and perhaps refer to a period when caves were used as habitations.

The 350th meeting was held November 17, 1903.

Dr. J. Walter Fewkes read a paper on the stone collars and tripointed images, or zemes, of Porto Rico. Doctor Fewkes illustrated his paper with large drawings of the types of these specimens. The collars, which are found almost wholly in Porto Rico, are fine examples of stone working, having gone through the process of carving and polishing after the rough work of pecking with a stone hammer. Each collar has an oval, flat, roughened area on one side.

The tripointed images are of five types: (1) Smooth, without decoration; (2) with conoid projection modified into a head; (3) with face on one side; (4) with head on the right and two legs on the left; (5) with four legs. Most of the images have human faces, though some are in the shape of animals and birds. In reference to the relation between the collars and the tripointed images, Dr. Fewkes called attention to the theory of J. J. Acosta that images generally have the same proportion and were placed on the flat surface of the collar and secured by cords. A specimen showing the feasibility of such junction was displayed. Dr. Fewkes said that there is no proof that these objects are not idols and that they show the representation of anthropomorphic gods in Porto Rico. Most of the collars seem to be serpent forms. In absence of data, however, there are still enigmas that require for their solution more field work and research, to which end Dr. Fewkes will devote this winter's labors in the West Indies.

In answer to an inquiry from the president, Miss Fletcher, Dr. Fewkes said that the triform images are geographical and resemble Yunque Mountain. In answer to a question from Mr. McGuire, Dr. Fewkes said there seem to be more triform images than collars, and he further remarked that the locality where the collars have been found has not been recorded.

The secretary mentioned that Professor Mason had remarked on the similarity between the cedar bark collars of the northwest coast Indians and the stone collars of Porto Rico.

Dr. John R. Swanton said that the resemblance is probably accidental and further said that if the Porto Rican collars were evidence of a serpent cult the art modifications might

be due to the transfer of the cult to a locality where serpents do not exist.

In reference to the human remains collected by Dr. Fewkes, Dr. Hrdlicka said that a comparison of the Porto Rican skull with South American skulls shows it to be like specimens from Brazil. In answer to an inquiry from Dr. Lamb, Dr. Fewkes said the bones were found in a mound near Utuado.

Under the head of voluntary communications, Dr. Hrdlicka suggested that archeological and anthropological work be carried on at Panama in connection with work on the canal.

The secretary presented data on the destruction of ruins in the southwestern United States, and suggested that the movement for their preservation inaugurated some years ago be revived. After a brief discussion in which the president, Dr. Kober, Dr. Fewkes and Dr. Hrdlicka took part, the matter was postponed to the next meeting. WALTER HOUGH,

*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### THE ANIMAL PARASITE SUPPOSED TO BE THE CAUSE OF YELLOW FEVER.

TO THE EDITOR OF SCIENCE: In your issue of October 23, 1903, you publish a communication from Mr. J. C. Smith, of New Orleans, in regard to the animal parasite in the bodies of mosquitoes infected from yellow-fever subjects. While the article is on its face contradictory and unsatisfactory, its burden is to claim the credit for scientific work to which he is not entitled. It reflects unfairly and unjustly upon Professor George E. Beyer, associate professor of biology in Tulane University, who was the biologist of the working party of the yellow-fever institute of the U. S. Public Health and Marine-Hospital Service, which made the investigations in Vera Cruz in 1902.

Professor Beyer is an acting assistant surgeon in that service, and for that reason can make no publication in the matter.

In the first paragraph of the article Mr. Smith claims that he was 'the first to have correctly interpreted and given value to the things found in the bodies of the mosquitoes infected from yellow-fever patients.' After setting forth this claim, he closes with the vastly more modest claim that he was entitled to have printed in the report of the working party an acknowledgment of his valuable services in working out the sexual life history of the parasite.

Mr. Smith fixes January 23, 1903, as the time when his assistance was asked, and his work was performed subsequent to that date.

The facts are that the working party discovered the animal parasite in mosquitoes infected from yellow-fever subjects in the summer of 1902, that they classified and named the parasite, illustrated it with drawings, and sent the drawings in November, and a preliminary report to the Surgeon-General in July of 1902, nearly six months prior to the time fixed by Mr. Smith. This report is an official record, is on file in Washington, and of itself shows that Mr. Smith was neither the discoverer nor the first correctly to interpret the parasite.

The eighth paragraph of the article does a particular injustice to Professor Beyer. It says: "Up to this time (January 23, 1903) Professor Beyer, who was the biologist of the party, knew of no evidence of a parasite in these mosquitoes, excepting some granular bodies, as they were styled, which were found in the cell of the salivary glands, and which I afterward showed the party were not granular bodies, but were linear bodies, five or six times longer than wide, the sporozites. On January 30 [1903] I reported having found in the bodies of a number of the mosquitoes an animal parasite in process of sexual development."

Professor Beyer had found this parasite six months before the time fixed by Mr. Smith as the day when he saw it in slides loaned him by Professor Beyer and known by the latter to contain the parasite. A number of physicians were acquainted with the discovery, its interpretation and value, in the summer and fall of last year. Dr. N. Del Rio in a statement acknowledged before the American Consul at Vera Cruz, June 8, 1903, says that as delegates of the Superior Board of Health of Vera Cruz, he, Dr. Matienzo and Dr. Iglesias were, during June and July, 1902, shown by Professor Beyer in the stomach and

glands of mosquitoes infected with yellow fever, an animal organism which the members of the American Commission classified as a Protozoan of the order of Coccidiida.

Dr. Henry R. Carter, a distinguished surgeon of the Public Health and Marine-Hospital Service, in a letter dated October 31, 1903, says that while attending the Public Health convention in New Orleans, on December 12, 1902, he visited Professor Beyer's laboratory in Tulane University, with several other physicians, and was shown a number of slides under the microscope. These showed, Professor Beyer told him, sections of the stomach walls, thorax and salivary cells of mosquitoes, with bodies which Professor Beyer claimed were the coccidium, and explained the stages in detail. Dr. Carter says that unquestionably, at that time, Professor Beyer claimed that his slides showed the sexual stages of a coccidium and that he had demonstrated the sexual cycle of a coccidium in the infected *Stygomyia fasciata*.

The proof that the work which Mr. Smith claims to have done in January of this year was all originally done in the summer of last year by the working party of the U. S. Public Health and Marine-Hospital Service is so clear that it is difficult to see how Mr. Smith could set up such a claim. The letter of Dr. Pothier which he prints in his article is contradictory of his claim.

Mr. Smith was consulted in January of this year and corroborated the work already performed. Ratification by a man of his undoubted high scientific knowledge was valuable. Professor Beyer has willingly counseled giving Mr. Smith all due acknowledgment, and has never sought to withhold all that he was entitled to, that is, due recognition of his assistance in demonstrating the life cycle of the parasite.

Mr. Smith has never published any interpretation of the coccidium different from the working party's. It is hard to see, therefore, how he was the first correctly to interpret the discovery when his interpretation was the same as that made by the working party months before.

I ask that you publish this refutation of Mr. Smith's claims in the same manner as his article. This request is made with no wish to provoke a controversy, but solely with a view to correcting an injustice.

I also suggest that a warning note be issued by you against a too hasty conclusion that the animal parasite discovered in infected *Stegomyia fasciata* be accepted as the cause of yellow fever. The working party's report makes no such claim. Surgeon-General Wyman recently issued a letter pointing out that this claim is not made. The value of the discovery of the coccidium lay in the fact that it pointed out a path for future investigation.

H. W. Robinson.

New Orleans,
November 28, 1903.

## *SHORTER ARTICLES.*

### THE NEW COSMICAL METEOROLOGY.

With every fresh outburst of large spots on the surface of the sun there is likely to be a sympathetic disturbance in the terrestrial magnetic and electrical fields, a change in the weather conditions of the world, and a recrudescence of popular interest in the subject. Speculation as to the causal connection between this solar action and the terrestrial effect is apt to become extravagant, even going to the length of seeking to identify particular spots on the sun with individual storms on the earth. This procedure overlooks some facts in the chain of events which in reality bind the two phenomena together, and it is the purpose of this paper to present in a somewhat orderly form the sequence as at present understood.

It has been found necessary to include both the sun and the earth in our meteorological research, and properly so, because the atmosphere of the sun is at work in sending energy, and the atmosphere of the earth is receiving energy, each through its process of convection and radiation. By these agencies, a special circulation is sustained in the atmosphere of the sun, and another in that of the earth, and the energy of one passing into the other binds the two together in a single cosmical thermal engine. Solar physics and astrophysics are evidently only other names for meteorology, which embraces all atmos-

pheric phenomena in its scope. The details of the work of the Weather Bureau in this research are being published as rapidly as possible, but as some time must elapse before this will be completed, it may be of interest to

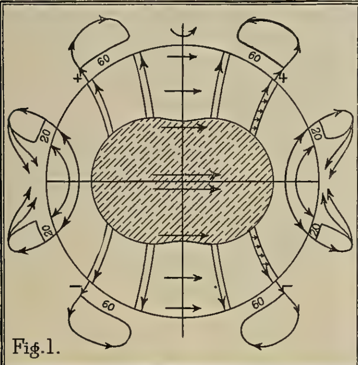

Fig. 1.

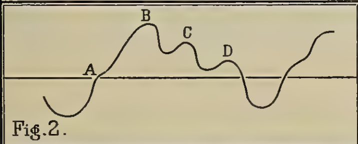

Fig. 2.

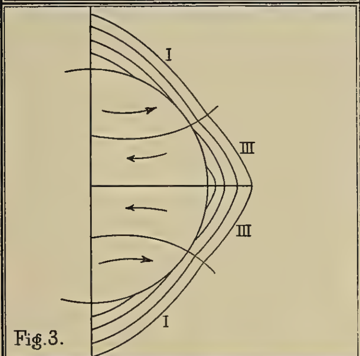

Fig. 3.

make a comprehensive statement of the conclusions that have been reached.

*The Circulation of the Sun.* (Fig. 1.)—The thermodynamic conditions in the sun suggest a viscous nucleus extending about half its radius from the center, which is surrounded by a gaseous envelope, the sun's proper atmosphere. The nucleus is apparently not spheroidal, but dumbbell in shape, according to the Jacobian ellipsoid of equilibrium, so that the sun is an incipient binary star with two centers of action instead of only one. This result rests upon the following facts: (1) The prominence frequency numbers on the surface have two distinct maxima, which move in opposite directions from the middle latitudes, one from latitude 25° towards the equator, as do the sunspots and faculæ, and the other from latitude 50° towards the poles, in the course of an eleven-year cycle. The cycle begins at minimum with a strong outpouring in middle latitudes, which separates into the two branches mentioned. It is probable that the congested energy of the interior first seeks to escape from the region where the viscous nucleus ends, and that one wave spreads through the gaseous region towards the end of the equator on the surface, while a second wave passes through the nucleus towards the center of the sun. The course of the maxima points, as shown in the *Monthly Weather Review* for January, 1903, favors this explanation. (2) The distribution of the prominences in longitude gives two maxima, located on two opposite meridians of the sun, as if they sprang from two foci. (3) This division of solar activity is also found recorded in the distribution of several other products of solar energy in the period of the solar rotation, which is 26.68 days on the equatorial plane, as in that of the sunspots and the faculæ, in one system of deflecting forces of the terrestrial magnetic field, in the barometric pressures and in the temperatures. That would be a good reason, if it exists, why the sun in its rotation should effect differential impulses throughout the cosmical system.

The periods of rotation of the sun have been determined in the several zones by a discussion of the prominence numbers, and there is retardation from the equator to the poles. This conforms to von Helmholtz's Case II., derived from the general equations of motion,

for discontinuous surfaces of different temperatures sliding past each other with different velocities, and rolling up vortex tubes between them. The layers are warmer around the axis of rotation of the sun, and have slower angular velocities than those more distant from it. The vortex tubes have the shape indicated in Fig. 1, right-handed in the northern hemisphere and left-handed in the southern. If the constituents of rotating matter carry electric charges in their atoms and molecules, this vortex entrainment will produce polarization and a true magnetic field extending outside the sun. The rotation period of the magnetic field near the poles, since it is primarily seated in the nucleus, is the same as that of the surface at the equator, namely, 26.68 days. The earth's normal magnetic field has a component system impressed upon it which is directed from north to south perpendicular to the ecliptic, and these vectors are probably portions of the lines here described as springing from the solar nucleus. Furthermore, all large cooling masses, contracting by their own gravity and rotating on an axis must, in conformity with the equations of motion, set up such a polarized internal structure, and, therefore, all stars are probably magnetic. The earth still possesses a residual magnetism originally produced in this manner, which is gradually fading away as the earth cools, and will become very feeble as the loss of convective heat progresses, somewhat like that of the moon at the present time. The belt systems on the planets Jupiter and Saturn afford examples of rotations with discontinuous surfaces, and minor vortices between them, under this law. The granulated surface of the sun is probably due to this vortex motion, where each granule represents the discharge of a single vortex tube.

*The Solar-terrestrial Synchronism.* (Fig. 2.)—The eleven-year cyclic period of the sunspot variation gives a curve with one principal maximum and one principal minimum, but this register of the solar action is not so sensitive as that recorded in some of the other elements. The eruptions of the sunspots and the faculæ are confined to the gaseous envelope, and do not directly represent the working of the viscous nucleus. The prominences of higher latitudes, 40° to 80°, produce the same fundamental curve, but there are minor crests superposed upon it, sometimes one on the ascending branch, *A*, and usually two on the descending branch, *C*, *D*. In some of the eleven-year cycles *A* does not appear, and one might count the length of the short period from the three crests, *B*, *C*, *D*, and make it, $11.1 \div 3 = 3.7$ years, as Lockyer has done. I have taken the four crests, *A*, *B*, *C*, *D*, and make the average period, $11.1 \div 4 = 2\frac{3}{4}$ years, as in 'Weather Bulletin' No. 21, page 125. This more sensitive curve registers primarily the action of the solar nucleus, and the minor crests are the recrudescences of a contracting and congesting medium seeking to free itself of supercharged energy. The curve is found to be repeated in a remarkable manner throughout the cosmical system. Thus, we have found, (1) that the periods of rotation in the higher zones of the sun, 50° to 70°, reproduce the curve in a secular variation, and refer its cause, without doubt, to the effects of internal circulation;* (2) that the magnetic field at the earth synchronizes with it;† (3) that the terrestrial temperatures in the tropical zones give the same curve directly, but in the temperate zones they synchronize in an inverted form; while the terrestrial pressures synchronize directly with it in the regions around the Indian Ocean, Australia, South Asia and Africa, but in an inverted form throughout North and South America. This inversion implies that there is a surging of the earth's atmosphere in the process of its general circulation, whereby a portion rises in pressure and temperature while another portion falls. This opens up a new field of meteorological research. A laboratory experiment, by means of cathode rays within a magnetic field, matches the observed distribution of the solar corona, and this is also in harmony with analysis of the sun's physical condition here outlined. The computed system of ordinary magnetic deflecting vectors and of the large magnetic storms which disturb the earth's normal field and fluctuate in

* See *Monthly Weather Review* for October, 1903.

† See *Monthly Weather Review* for July, 1902.

the same curve as the solar circulation, is directed upon the earth in polar curves as if coming from a distant spherical magnet, and not along the radial lines of electromagnetic radiation. It is not easy to account for these disturbances by flights of ions from the sun along the lines of the electromagnetic mechanical pressures. The further the discussion of the cosmical observations is pressed, the more positive becomes the evidence that the sun sustains a strong magnetic field, which responds to a variable magnetization within its nucleus. Radiation from the solar surface has another source of energy, namely, the atomic and molecular vibrations of the constituents of the outer envelope, as the photosphere, and hence much may go on at the surface which is not immediately representative of the state of the nucleus. Thus, the outpouring of heat, light and the ions streaming along the radii of electromagnetic pressure, together with the curved rays seen in the corona, consisting of positive and negative charges of electricity moving about a magnetic field, may take place at a given time in one way, while the nucleus is operating temporarily in another manner. Thus there may be divergences instead of synchronisms between the individual outbursts of spots and prominences on the solar surface as compared with the terrestrial magnetic storms and auroral displays which proceed from the nucleus, without in the least invalidating the claim that in general substantial synchronism exists. When sufficiently long intervals are taken, as a year, or possibly a few months, the conditions of the earth's atmosphere are affected by and vary with the changes in the solar processes. There has been much confusion in scientific writings arising from the failure to distinguish between physical actions at the surface and the interior of the sun, and many unsound criticisms have been published in consequence of it. The problem is complex, but with the growth of reliable data it is becoming yearly more promising of a satisfactory solution, and it is always interesting.

*The Circulation of the Earth's Atmosphere.* (Fig. 3.)—The meteorological theories of the motions of the atmosphere of the earth are now in a transition state; the old are passing away, and new ones are being constructed. Ferrel's theories of the structure of cyclones and anticyclones, as well as of the general cyclone of the hemisphere, have crumbled under the strain of modern observations. The 'Cloud Report' of the Weather Bureau, 1898, discarded both the Ferrel and the Oberbeck local and general vortices, and indicated a new path of research. The International Meteorological Committee has at last reached the same conclusion. (See 'Reports' for 1902 and 1903.) The problem at present is one of rebuilding in conformity with the facts. The general equations of motions were very briefly discussed by H. von Helmholtz, who introduced into them potential temperatures, in place of the density, and the corresponding constant angular momenta. From these equations arise three distinct cases, one of which was considered somewhat fully by him. The second case has been applied by Emden to solar circulation as above indicated, and the third case has not yet been sufficiently recognized by any one. Case I. shows that there are discontinuous surfaces of separation between layers having different temperatures and velocities, and that in the earth's atmosphere these should extend from about latitude 35° towards the poles, rising higher above the surface with progress poleward. Case III. gives surfaces sloping towards the earth from the equator up to about latitude 35°. This system differs entirely from Ferrel's, which adopted the canal theory of circulation with poleward currents at high elevations. These do not in fact exist, but there is evidence that the surfaces here specified are in conformity with the observed circulations as modified by mixtures. The local cyclones of the temperate zones are built up of counter currents of different temperatures derived from these general conditions, which in low levels near the surface of the ground underflow the eastward drift of the upper strata. The configuration of the isobars of the local cyclones observed on the sea level extends upward two or three miles with diminishing intensity, till absorbed in the system of normal isobars pertaining to the season of the

year. These two sets of isobars have now been separated from each other, and the proof of this statement is positive. (See 'Barometry Report, 1901; *Monthly Weather Review*, January, 1903; and another forthcoming report.) The prevailing stream lines, velocities and temperatures in high levels have been determined for the United States (see 'Cloud Report,' 1898), and are being worked up for the West Indies (report in preparation). The potential temperatures can be computed for both regions from the data in hand, and they are such that the heat of the upper strata of the temperate zones, where there is eastward flow increasing with the height, is above the quantity called for by the adiabatic law. In the tropics, with westward velocities diminishing upward, the heat of the upper strata is probably below the adiabatic quantity, though this remains to be determined. We have had since December, 1902, daily isobars for the United States on the three planes, the sea level, the 3,500-foot, and the 10,000-foot planes, and the result of the intercomparison of their varying configurations throughout the year is in conformity with this analysis. They possess much advantage in practically forecasting the areas of precipitation, the direction of storm tracks, and the rapidity of the propagation of the cyclonic areas over the United States.

Frank H. Bigelow.

Weather Bureau,
November 30, 1903.

### HORTICULTURAL VARIETIES OF COMMON CROPS.

The improvement of farm crops by breeding and selection has received a marked impetus in recent years, due partly to the success secured by a few pioneer workers in this field, and partly to recent discoveries in the laws of heredity. The present note is written for the purpose of calling attention to a method of improvement that has been applied to ordinary field crops only to a very limited extent, but which offers promise of immediate and marked results. It can be best illustrated by giving actual cases. Dr. A. D. Hopkins, at present connected with the Bureau of Entomology of this department, formerly of the West Virginia Experiment Station, for many years grew timothy for seed. For this purpose the crop is ordinarily sown thinly, so that, during the first harvest year, the plants are sufficiently distinct to permit of the observation of individual plants. Many years' close observation showed that the crop consists of a large number of constantly recurring forms quite easily distinguished. A number of plants, each representing one of these forms, were taken up and separated into as many parts as the nature of the case permitted; in this way each plant became the parent, by divisions, of a large number of plants, all set side by side in a plat. When seed was harvested from these plats it was found that the plants produced from these seeds reproduced faithfully the characters of the original selection. Each original selection, therefore, became the parent of a variety. Several of these varieties are now growing in the grass garden of the Department of Agriculture, where they have been the object of careful observation during the past season. They differ markedly in character of growth, earliness, size, etc. Some of them are evidently far superior to the ordinary timothy as grown by farmers (which is a mixture of superior and inferior varieties), some for seed production, others as hay plants, and others as pasture plants.

In a manner exactly similar, Mr. A. B. Leckenby, director of the Eastern Oregon Experiment Station, has isolated ten varieties of brome grass (*Bromus inermis* Leyss.), as distinct, for instance, as the ordinary varieties of wheat. He has also isolated a larger number of varieties of *Poa pratensis*, differing to a remarkable degree in character of growth, and consequently in agricultural value.

This method of securing new and stable varieties is probably applicable to all unimproved crops that are ordinarily close-fertilized. In the case of cross-fertilized species, a different procedure would be necessary; but if Mendel's law holds in these cases, similar results can be secured even in cross-fertilized species by artificially close-fertilizing the plants. In this case, the plants would immediately split up into a number of stable forms that could be segregated as varieties by isolating them from other forms.

The origin of these varieties which are

found in stable form in close-fertilized species (and which exist potentially in cross-fertilized species) is a matter of great interest, both theoretically and practically. The adherents of the mutation theory will see in them a confirmation of their views. The rest of us are compelled to admit that, thus far, their origin is obscure.

In the light of the facts cited, the question whether a given crop is cross- or close-fertilized becomes a matter of prime importance, as different methods of procedure are required in the two cases. Dr. Hopkins states that clover plants selected in a manner analogous to that described for timothy did not reproduce true to seed, but that the plants grown from the seed of a single plant represented all the forms observable in the original field of clover. This is what Mendel's law leads us to expect, if clover is cross-fertilized, a matter which has recently been called in question. It is easily seen that we have here a list of important problems for plant physiologists, in determining definitely what crops do and what do not cross-fertilize. There is likewise a broad and promising field of work in securing in a stable form superior strains of all ordinary crops to which these methods have not already been applied. The amount of improvement possible represents the difference between the mixture of all strains and the best components of the mixture.

W. J. SPILLMAN.

U. S. DEPARTMENT OF AGRICULTURE.

## *RECENT ZOOPALEONTOLOGY.*

### FIELD EXPEDITIONS DURING THE PAST SEASON.

THE Kansas chalk was visited by three parties during the summer. The first, under Professor S. W. Williston, representing the University of Chicago, was extremely successful, especially in procuring remains of mosasaurs, pterosaurs and toothed birds; the collection will be arranged principally as a study collection in the university. The second party represented the Carnegie Institution of Pittsburg, and is reported to have been very successful also. The third party was that of Mr. Charles H. Sternberg in the same field. He writes that he collected over sixty specimens of Cretaceous fossils, including especially well-preserved specimens of the turtles. *Protostega gigas* is represented by three skulls and a complete skeleton. The skeleton lay on its dorsal surface with the fore limbs stretched out at right angles to the median line of the carapace, measuring six feet between the ungual phalanges; the hind limbs were parallel with the neural arch, and stretched out behind. Mr. Sternberg also secured a number of mosasaur skulls, with portions of the skeleton of *Platecarpus* (one individual included sixty-six continuous vertebræ behind the skull); also skulls of each of the three genera of mosasaurs, the skeleton of *Portheus,* and skulls and skeletons of a number of other genera of fishes. It appears that erosion of the chalk is quite rapid, and there are practically fresh exposures in many parts of this famous region.

Professor Loomis, of Amherst College, who has been for some years with the American Museum of Natural History expeditions, during the past season conducted a party from Amherst into South Dakota. A collection including the remains of some 500 animals was made, chiefly in the White River beds, the best specimens being the skeleton of a titanothere and of an oreodon.

Princeton University sent an expedition under Dr. Marcus Farr into the Laramie and Judith River Beds of Montana. It is reported as having been very successful.

The American Museum of Natural History sent four parties into the field. The first, the third Whitney Expedition for fossil horses, worked in western Nebraska and South Dakota, and added considerably to the collection of fossil horses already in the museum. The choicest specimen found by this party was the skeleton of *Camelus occidentalis.* The second party worked in the Bridger Beds of western Wyoming under Mr. Walter Granger, and was successful in securing a representative collection of the small fauna of that region. The third party, under Mr. Peter Kaison, continued the excavation of the Bone Cabin Quarry in the Como region, the chief discoveries being a fore limb of *Morosaurus,* a skull of *Diplodocus,* portions of another skeleton of *Stegosaurus* and a very large

collection of the limb bones of *Camarasaurus* from the Reed Quarry. The fourth expedition went into South Dakota and northern Wyoming, under Mr. Barnum Brown, and resulted particularly in the discovery of abundant mosasaur and plesiosaur material.

The explorations of the Carnegie Museum have been described by Mr. Hatcher in a recent number of SCIENCE.

Mention should also be made of the continuation of the explorations in the Triassic under Professor Merriam, of the University of California, as well as of the cave fauna in Shasta County, a description of which has already appeared in SCIENCE. H. F. O.

## *BOTANICAL NOTES.*

### THE MISSOURI BOTANICAL GARDEN.

THE appearance of the Fourteenth Annual Report of the Missouri Botanical Garden covering the year ending December 31, 1902, enables us to note the rapid growth of this institution. The report shows that the income from all sources for the year was $127,142.50 and that considerably more than one half of this amount was expended on the garden, including library, herbarium, salaries, etc. The total number of species of plants now in cultivation in the garden is 11,551, which is more than double the number grown in 1895. The herbarium now includes 427,797 specimens. During the year there were added no less than 62,844 sheets of specimens. The botanical library was increased by more than 2,000 books and pamphlets, bringing the total number up to about 42,000. Other interesting statistics are given, showing that the garden has been an active agent in the promotion of botanical knowledge.

The bulk of the volume is taken up with a paper by Alfred Rehder under the title of 'Synopsis of the Genus *Lonicera*,' covering 206 pages, and including twenty full-page plates. The lapse of seventy years since the last general revision of the genus in the fourth volume of DeCandolle's 'Prodromus' makes such a paper as this especially necessary. This is shown by the fact that of the 154 species recognized in this monograph, but 42 occur in the 'Prodromus.' The conservative treatment accorded to the genus is indicated by the small number of new species (eleven, only) which the author has described. Such moderation, after the 'lying fallow' of this particular botanical field for so long a time, should put to shame our 'species makers.' In this the Missouri Botanical Garden has rendered a distinct service to botanical science.

### AN ELEMENTARY JOURNAL OF MYCOLOGY.

ABOUT a year ago Professor Kellerman, of Columbus, Ohio, began publishing a leaflet for the benefit of those who wish to learn something about the fungi. He called it the *Ohio Mycological Bulletin* and filled it with excellent photoengravings of the larger fungi. With each picture was given a simple description adapted to the understanding of 'children in years and children in knowledge.' It has been so successful that practically all of the earlier numbers have been exhausted. The first volume, which includes twelve numbers aggregating forty-eight pages, closes with a good index. With the last number a title page for the volume is supplied. The new volume is to start with the new year, and it is announced that 'the frequency of issue during the year will depend on the financial receipts.' The hope is expressed that two numbers a month may be issued during the spring and fall. For teachers in the public schools who wish to learn to know the commoner large fungi nothing better than this is published anywhere.

### SOME RECENT PAPERS ON SYSTEMATIC BOTANY.

WILLIAM R. MAXON in the 'Contributions from the United States National Herbarium' (Vol. VIII., part 3) publishes 'A Study of Certain Mexican and Guatemalan Species of *Polypodium*,' in which he notices eight species, five of which are new to science. Two good plates illustrate the paper.

In the September number of the *Bulletin of the Torrey Botanical Club* Dr. G. N. Best revises the mosses of the genus *Leskea*, so far as the North American species are concerned. Ten species are recognized, two of which are new. He finds two new varieties also. The paper is accompanied with two plates showing structural details.

In the October number of the *Journal of the Linnean Society* the 'Enumeration of all the Plants known from China Proper, Formosa, Hainan, Corea, the Luchu Archipelago and the Island of Hongkong,' by Francis B. Forbes and William B. Hemsley, is carried forward nearly through the Cyperaceæ. As the sequence is that of Bentham and Hooker, it is likely that a few more numbers will see the end of this great work.

In No. 247 of the *Journal of the Linnean Society* (dated October, also) W. and G. S. West publish an interesting paper on the 'Scottish Freshwater Plankton,' which shows that the Scottish phytoplankton 'is unique in the abundance of its desmids.'

CHEMISTRY OF PLANT AND ANIMAL LIFE.

PROFESSOR SNYDER, of the University of Minnesota, has compiled a handy little volume under the title of 'The Chemistry of Plant and Animal Life,' which merits a notice here, since it is an attempt to place within reach of the beginner many of the chemical facts which otherwise are inaccessible to him. It is an elementary treatise and was originally prepared for the students in the school of agriculture of the university. This made it necessary that the treatment should be quite simple, and as nearly non-technical as possible. It is not, therefore, a 'contribution' to science, but it is a contribution to the pedagogics of science. The author has found how to present the subject for the class of students under consideration; a class characterized by great earnestness and a desire to learn all that can be reached, but whose scholastic preparation is somewhat defective. Difficult as is the problem, Professor Snyder has successfully solved it. He first gives about twenty chapters to a simple statement (with experiments) of general chemistry, and follows these with such topics as 'the water-content of plants,' 'the non-nitrogenous organic compounds of plants,' 'the nitrogenous organic compounds of plants,' 'chemistry of plant growth,' 'composition of fodders,' 'composition of wheat,' etc. The book, while a simple one, and no doubt here and there open to the criticism of some confusion of details, is without question one which will be of great service to beginning students, especially in the schools of agriculture. A new edition is under way, and is to appear soon. It should find place in many schools.

CHARLES E. BESSEY.

THE UNIVERSITY OF NEBRASKA.

## THE CARNEGIE INSTITUTION.

THE trustees of the Carnegie Institution have approved the recommendation of the executive committee that $10,000 be granted for twenty tables at the Marine Biological Laboratory at Woods Hole, Mass., for 1904. Applications received prior to February 1, 1904, will be considered, and twenty persons assigned to the tables at the laboratory, for the season of 1904.

The trustees have also approved of an appropriation for two tables at the Naples Marine Biological Station, for which applications will be received and considered up to February 1, 1904.

It is desirable that all applications for research assistantships shall be in the hands of the committee by February 1.

The regulations in regard to the research assistantships are as follows:

It is the purpose of the Carnegie Institution of Washington, among other plans, to encourage exceptional talent by appointing a certain number of research assistants.

These positions will not be those commonly known as fellowships or scholarships; nor is the object of this provision to contribute to the payment of mechanical helpers or of assistants in the work of instruction. It is rather to discover and develop, under competent scrutiny and under favorable conditions, such persons as have unusual ability. It is not intended to provide means by which a student may complete his courses of study, nor to give assistance in the preparation of dissertations for academic degrees. Work of a more advanced and special character is expected of all who receive appointment.

The annual emolument will vary according to circumstances. As a rule, it will not exceed $1,000 per annum. No limitations are prescribed as to age, sex, nationality, graduation or residence. Appointments will, at first, be made for one year, but may be continued.

It is desirable that a person thus appointed should work under the supervision of an investigator who is known to the authorities of the Carnegie Institution to be engaged in an important field of scientific research, and in a place where there is easy access to libraries and apparatus—but there may be exceptions to this.

Applications for appointments may be presented by the head of, or by a professor in, an institution of learning, or by the candidate. They should be accompanied by a statement of the qualifications of the candidate, of the research work he has done, and of that which he desires to follow, and of the time for which an allowance is desired. If he has already printed or written anything of interest, a copy of this should be enclosed with the application.

Communications upon this subject should be distinctly marked on the outside envelope, and on the inside, 'Research Assistant,' and should be addressed to the Carnegie Institution of Washington, Bond Building, Washington, D. C.

## *SCIENTIFIC NOTES AND NEWS.*

As all our readers know, the American Association for the Advancement of Science, the American Society of Naturalists and about twenty affiliated societies are meeting this week at St. Louis. Several of the most important national societies devoted to the biological sciences, or their eastern branches, are meeting in Philadelphia. The American Philosophical Association is meeting at Princeton, and there are more or less local meetings in other cities. At the time of going to press information in regard to these meetings has not reached us; but we shall as usual publish full reports in the issue of next week and in subsequent issues.

M. Emile Bertin has been elected a member of the Paris Academy of Sciences in the section for geography.

M. H. Gréhant, professor of physiology in the Paris Museum of Natural History, has been elected a correspondent of the Philadelphia Academy of Natural Science.

Professor Ludwig Boltzmann, of Leipzig, has been elected an honorary member of the Academy of Sciences at Moscow.

Professor Otto Bütschli, professor of zoology and paleontology of the University of Heidelberg, has been appointed an honorary member of the Universities of St. Petersburg and Moscow.

The honorary doctorate of the University of Marburg has been conferred on Dr. Thedor Tschernyshew, of St. Petersburg, director of the Russian Geological Committee.

The University of Munich has conferred an honorary doctorate of philosophy on Mr. L. Cockayne, of Christ Church, New Zealand.

Mr. A. J. Eveland, a graduate student in geology and mineralogy of the Johns Hopkins University, has been appointed geologist to the Mining Bureau established by the United States Government in the Philippine Islands.

Mr. John Shafer, formerly custodian of botany at the Carnegie Museum of Pittsburg, has been appointed custodian of the Museum of the New York Botanical Gardens.

Professor Paul Ehrlich, director of the Royal Institute for Experimental Therapeutics at Frankfurt, a/M, will deliver the first course of Herter lectures at the Johns Hopkins University Medical School. Professor Ehrlich's lectures will be in German, and will probably present the results of his researches on immunity.

Dr. G. Sims Woodhead, professor of pathology at Cambridge University and member of the Royal Commission on Tuberculosis, gave the third Henry Phipps Institute lecture on December 29 at Philadelphia, his subject being 'Paths of Infection in Tuberculosis.'

The Bradshaw lecture was delivered before the Royal College of Surgeons on December 9 by Mr. Henry Morris, the subject being 'Cancer and its Origin.'

A special meeting of the Scottish Geographical Society was held at Edinburgh on December 17, under the presidency of Professor James Geikie. An address was delivered by Sir Thomas H. Holdich on 'The Patagonian Andes.'

A CABLEGRAM to the daily papers states that Dr. Alexander Graham Bell arrived at Genoa on December 27. He will convey to the Smithsonian Institution at Washington, D. C., the remains of James Smithson, founder of the institution, who died in Genoa in 1829.

WE learn from the *Botanical Gazette* that the large herbarium of the late Professor C. Haussknecht will be maintained by his family under the auspices of the Thuringian Botanical Society.

IT is announced that Dr. Oscar Guttmann has presented to the London Chemical Society a photograph of the portrait of Roger Bacon in possession of Lord Sackville at Knole House, Sevenoaks.

DR. FRIEDRICH GOLL, professor of pharmacology at Zurich, has died at the age of seventy-three years.

WE regret to record the death of M. Proust, professor of hygiene of the University of Paris and inspector general of the Sanitary Service; of Dr. Eugene Askenasy, honorary professor of plant physiology at the University of Heidelberg; and of Dr. Ottmar Schmidt, professor of chemistry in the Institute of Technology at Stuttgart.

DR. P. CHALMERS MITCHELL, secretary of the London Zoological Society, writes to the London *Times:* The recent death of the Polar bear, a popular favorite at the Zoological Gardens since 1895, has caused some interest and has been the occasion of many published comments based on inaccurate information. Perhaps you will allow me space to state the facts. The bear was in good health and spirits and fed well until the afternoon of Sunday, November 1, when, soon after taking food, it fell backwards and died almost instantaneously. The *post-mortem* changes were unusually rapid, and next day an examination was made in the presence of Mr. Beddard, the society's prosector, and myself, and a preliminary diagnosis was arrived at. Subsequently Dr. Salaman, pathologist to the London Hospital, a fellow of the society, who has very kindly placed his services at the disposal of the society until the return from abroad of the special pathologist recently appointed by the council, made a careful examination of the material that we had reserved, and established the correctness of the preliminary diagnosis that the cause of death was an aortic aneurism. The case was of great scientific interest, and Dr. Salaman will communicate to a future scientific meeting of the society a detailed account of it. I may say now, however, that, except for the local lesion, the organs and tissues were healthy, and it is extremely improbable that the creature suffered. It would have been impossible to make the diagnosis during life, or, had we known of the existence of the disease, to have taken any steps for its treatment. I may add that, while in the past very considerable additions to anatomical knowledge have been made at the prosectorium attached to the gardens, the council of the society, by increasing the accommodation for pathological work and by appointing a special pathologist, hope that additions to knowledge of the treatment of animals will be made.

BARON EDMUND DE ROTHSCHILD has placed in the hands of M. Albert Gaudry, president of the Paris Academy of Sciences the sum of 10,000 francs to enable him to secure for the Paris Museum of Natural History the more valuable specimens in the Filhol paleontological collection.

ACCORDING to Reuter's Agency, Mr. Bruce, the leader of the Scottish Antarctic Expedition which was sent out last year on board the *Scotia,* has arrived at Montevideo from the Falkland Islands. He reports that all is well in the *Scotia,* which is on the way to Buenos Ayres. Six men have been left behind in charge of a meteorological station. The news of the safe return of the Scottish Antarctic Expedition has come some two or three months earlier than was expected. It was not originally Mr. Bruce's intention to winter in the Antarctic, but it was understood that if he did so nothing would be heard of the expedition after its departure from Port Stanley, Falkland Islands, until March of next year. The meteorological station referred to by the explorer at which six of his men have been left appears to be the station set up by Mr. Bruce at Cape Pembroke, Falkland Islands,

before the *Scotia* left for the southern seas in January last.

The National Geographic Society has recently moved into its new home, the Gardiner Greene Hubbard Memorial Hall. As the building is not entirely completed, the formal opening of the hall will be deferred for the present. The society offers three courses of meetings during the season of 1903–1904—a regular or scientific series of ten meetings; a popular series of ten illustrated lectures, and an afternoon or lenten series of five popular lectures.

A special Roentgen Congress and Exhibition is to be held at Berlin during the spring to celebrate the tenth anniversary of the discovery of the X-rays. Professor Roentgen is expected to be present at the congress. Further information can be obtained from Dr. Immelmann, Lützowstr. 72, Berlin, W., Germany.

The annual dinner of the Institute of Chemistry of Great Britain took place on December 14. Speeches were made by the president, Dr. Davis Howard, Sir William Huggins and Sir William Ramsay.

The Canadian papers state that at a meeting of the board of directors of the Canadian Forestry Association, held at the office of Mr. E. Stewart, Dominion Superintendent of Forestry, the treasurer reported the receipt of a grant of $300 from the Government of Ontario to assist in the work of the association, and that the governments of Quebec and British Columbia had also promised assistance. The membership has reached the number of 420, and, with the improved financial position in which the association finds itself, it is proposed to extend the sphere of its activities. The establishment of a journal devoted specially to forestry interests was discussed, and it was decided to report favorably to the annual meeting. The publication will, if started, be managed by the association, and will probably be at first a quarterly, with the expectation of being finally issued as a monthly. It is hoped in this way to call public attention more distinctively to the work of the association, and to the importance of proper forest management.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

At the forty-ninth quarterly convocation of the University of Chicago President Harper announced that Mr. John D. Rockefeller had given to the university $1,500,000 in real estate and $350,000 in cash. A donor, whose name was not made public, has given $1,096,466 for a special purpose not yet designated.

It is stated that Mrs. Phoebe Hearst will provide a building for the Department of Botany of the University of California.

A gift of $1,000 from Edward Mallinckrodt, of St. Louis, has enabled the department of chemistry of Harvard University to refurnish the library of Boylston Hall and to buy several hundred new books. E. Mallinckrodt, Jr., has added to this a sum to be paid annually for the next five years to defray the running expenses of the library. The collection of books has also been enlarged by several gifts from Dr. Wolcott Gibbs.

We learn from the London *Times* that the late Mr. Charles Seale-Hayne, M.P., has under his will provided for the establishment of a College of Science, Art and Agriculture in the neighborhood of Newton Abbot, open to students of the county of Devon. Details will be left to the executors. It is thought that about £150,000 will be handed over for the college.

Dr. Horace Clark Richards, instructor in physics in the University of Pennsylvania, has been promoted to an assistant professorship of physics.

Mr. Henry Balfour, M.A., of Trinity College, Oxford, has been elected to fellowship at Exeter College. Mr. Balfour has been for some years curator of the Pitt-Rivers Museum. He is also president of the Anthropological Institute, and president-elect of the Anthropological Section of the British Association for 1904.

Dr. Hermann Grassmann, docent at Halle, has been promoted to an assistant professorship of mathematics.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 8, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *CONVOCATION WEEK.*

The second of the convocation week meetings of scientific and learned societies leaves no doubt as to the wisdom of the general plan, though it is evident that a final solution can only be reached by gradual evolution. The meetings held at St. Louis, Philadelphia, Pittsburg, Princeton and elsewhere brought together large groups of scientific men, and the programs of papers and other features, both formal and informal, were satisfactory and profitable. With the exception of the first of the convocation week meetings held last winter at Washington, when practically all the scientific societies met together, so many scientific men have not simultaneously attended the meetings of their societies. Last winter there was some friction in the relations of the numerous societies meeting together for the first time and partly confluent in their scope; but such friction naturally leads to attrition and adjustment. When individuals or societies are isolated there are always excrescences in process of formation, which require friction for their removal.

We can not, consequently, regard the meetings this year as wholly satisfactory. The attendance of the meeting of the American Association and its affiliated societies at St. Louis was not as large as had been expected. It seems unfortunate that

the American Society of Naturalists should have met at a different place from many of the national societies devoted to the biological sciences which have usually been affiliated with it; that the newly formed Paleontological Society should have met apart from the Geological Society; that the psychologists should have met at St. Louis and the philosophers at Princeton; the mathematicians of the central states at St. Louis and those of the eastern states in New York, and the like. The vast area of the country makes sectional meetings inevitable, but it can scarcely be assumed that the arrangements this year were the best possible.

This journal has consistently advocated a convocation week meeting of our national societies, in which all shall be represented, if not by sessions and programs, then by delegates. One of the most important problems of the present decade is the proper affiliation of men of science to promote their interests, which we sincerely believe represent the interests of civilization. Combinations of labor and of capital may be purely selfish, promoting the interests of one class at the expense of another, though there is good reason to hope that in the end trades unions and corporations will benefit the whole community; but from the very outset every advance in science is for the benefit of all. Faraday and Henry investigated the phenomena of electromagnetism in the laboratory; others joined in the work and gave us the telegraph, the telephone, the electric motor and the rest, adding billions of dollars to the wealth of the world. The direct and indirect work of a single man, such as Liebig or Pasteur, adds more to the common wealth than all the scientific men that have ever lived have drawn from it. The material contributions of science are obvious and trite; but it is sometimes not fully realized that the social and intellectual results are even greater. All our mental, social and esthetic ideals have become clarified. Great men lived before the dawn of modern science, greater perhaps than any now living, but their activity was often fragmentary, and in many directions childish. The doctrine of evolution and other scientific concepts are now the common heritage of every one, guiding all thought and all action.

It is entirely reasonable to urge that whatever advances science must benefit every one; first perhaps an individual, but then a class, a country and the world. This truth must be impressed on the whole people; and it must be done by those who realize it most fully, that is by scientific men themselves. Much progress has indeed been made in this country. The national government does more for scientific work than any other; the states and municipalities do more; private gifts to universities and scientific institutions are larger, far larger, than elsewhere. But this is a matter of the last twenty years; we have only begun. The United States must assume the leadership in science, not only for its own advantage, but also for the welfare of civilization.

Our press, the pulpit, legislative bodies, public sentiment generally, are well meaning, but excessively crude. Scientific men have a large problem in education before

them, and it must be admitted that education must begin at home. All dissensions and petty quarrels are harmful. There is too much rivalry and too little cooperation in scientific work. We inherit from a long past certain competitive tendencies which should become obsolete. The attainment of priority, degrees, honors, membership in exclusive societies, and the like, have been largely the rewards of scientific men. Better no heaven than one with a limited seating capacity, for which each strives to the exclusion of others. It is less selfish to seek wealth by producing new wealth which is shared by all, than to attempt to secure honors at the cost of depreciating others.

The moral intended is, of course, that scientific men should unite to promote their common interests. A single individual should subordinate his interests to those of the group, and a single society to those of the general organization of societies. It is fortunately the case that the interests of the individual usually coincide with those of the group; the conflict is more often between the temporary and permanent interests of an individual or of a group. The theory of evolution tells us that this conflict is due to maladjustment, the environment having changed more rapidly than the individual or the group has been able to adjust itself to it.

This appears to be the case just now in the organization of science. Scientific workers have increased fivefold in from ten to twenty years; new and specialized lines of scientific work have arisen; the geographical center of scientific population and interest is moving from the eastern seaboard toward the west. The organization that sufficed twenty years ago is no longer adequate. Special societies for each science have arisen and regional and local sections have been formed. Organic fusion must be slow, but better progress can be made by intelligent guidance than by submission to the wasteful processes of natural selection. No one can lay out a valid program for the future, but suggestions can be made subject to the survival of the fit, among which the waste by failure is less than in the case of experience by the rule of thumb.

The Smithsonian Institution, the National Academy of Sciences and the Carnegie Institution, each has had an opportunity to become the center of scientific organization for the country, and each has completely failed. This is not altogether regrettable. We live in a democratic age and community; government by representation is better than any aristocratic or despotic form, however benevolent. The organization of the council of the American Association adapts it for becoming the chief center for scientific organization. The association represents the entire country and all the sciences. If any regions are inadequately represented in its membership or any sciences are not included in its scope, this need not continue to be the case. The council is not only the representative body of the association, but also of all scientific societies that wish to be represented on it. It is not known to every one that any scientific society may by vote of the council become affiliated with the association. In this case it sends one or two delegates, accord-

ing to its size, to the council, and has the option of meeting with the association; its members, even when not members of the association, enjoy all the privileges of reduced rate of transportation, provision of place of meeting, entertainments, etc., provided by the association. At the same time the society retains its complete autonomy. It can meet when and where it likes, and if it meets with the association its scientific program and other functions remain entirely under its own control. The association has been liberal and catholic in its treatment of affiliated societies. For example, at the meeting last week the Society of College Teachers of Education and the Society for Horticultural Science were admitted to affiliation. Some societies, as the American Chemical Society and the American Physical Society, met at St. Louis in conjunction with the corresponding sections of the association; others, as the Geological Society of America and the American Botanical Society, provided independent programs. No society that has met several times with the association has shown any disposition to separate itself from it. Different societies may hold independent meetings in summer or even in convocation week, but they will not break an affiliation that has proved useful for the society, for the association and for the general progress of science. If any society is unwilling to become affiliated with the association, it is probably due to ignorance of the conditions.

The American Association, the American Society of Naturalists and about twenty affiliated societies, including all those devoted to the physical sciences and many of those devoted to the natural sciences, met together at St. Louis. It was believed by many members of the council that it was undesirable to select St. Louis as the place of meeting this winter. The council has in recent years recommended a place of meeting two years in advance. When the meeting at St. Louis was first discussed at Denver, it was supposed that it would be last summer in connection with the exposition. The exposition was postponed for a year, and the association changed its time of meeting to the winter. It would probably have been wiser for the association to have continued its summer meetings, at least until the relative advantages of winter and summer meetings had become evident. If the association and such of the affiliated societies as had wished had met last summer at Ithaca, this winter at Philadelphia and next summer at St. Louis in conjunction with the Congress of Arts and Science, the conditions would have been more satisfactory than is the case at present. But at Washington the council of the association had no definite knowledge of the congress of the exposition, the chemists had met at Philadelphia the year before, and no one could have supposed that the eastern branch of the Zoological Society and other biological societies would have met at Philadelphia, when it was known that the association would meet there next year. Scientific societies, like national governments, have a way of muddling through; but it is surely reasonable to suppose that men of science should be the first to

apply scientific methods to their own guidance.

The American Association and a majority of our scientific societies will meet next year at Philadelphia and the following year at New Orleans. Other societies should adjust their plans to this definite program. It may be desirable for the naturalists of the central states to hold a meeting of their own next year and for the naturalists of the eastern states to hold a separate meeting the following year, and individual societies may like to meet sometimes apart from the general meeting. But it would be unfortunate to have two competing groups of naturalists meeting next year at the same time and in the same region. If this should occur, it would not be the result of the wishes of the general body of naturalists, but through misunderstandings on the part of a few officers. If any of the societies that met at Philadelphia last week are unwilling to return next year, or wish to hold meetings apart from the main group, it is to be hoped that they will meet separately in small university towns, rather than undertake to organize a conflicting group.

It would be desirable for the council of the American Association, representing the association and affiliated societies, to lay out its program even more than two years in advance, it being of course always adjustable to new conditions. There appears to be no valid argument against both summer and winter meetings. It entails extra labor on the secretaries, but they should be adequately paid, and different summer and winter secretaries could be elected should this prove desirable. The council of the association should and does meet twice a year, and it appears that a summer meeting would be a better occasion than the time of the meeting of the National Academy at Washington. A summer meeting, supposing waste on printing programs and the like to be eliminated, would increase the receipts more than the expenditures; in any case the association has an ample income, having been able in recent years to turn over large sums from the income to the permanent funds. Since the New York meeting of the association, when it was decided to send SCIENCE free of charge to all members, the membership has increased from 1,700 to over 4,000. If seventeen hundred members—there were actually but twelve hundred who were in full standing—could hold one meeting annually, four thousand members can hold two. It is nearly always a mistake for those who do not want to do a thing to say to those who do: You must not. With the exception of certain officers, most of whom might be elected in duplicate, no one need attend any particular meeting of the association. If the work were somewhat differentiated there would be ample room for two meetings a year, with a satisfactory attendance and program at each.

We look forward to seeing the convocation week meeting in midwinter the great assemblage of American men of science, where all societies will be represented either by a plebiscite or by delegates, which will impress on the public at large the weight and magnitude of scientific work. The

meeting should be essentially an affiliation of scientific societies, but they should when convenient confine their special programs to the mornings, leaving the afternoons to the sections of the association, two or three of which should arrange for each afternoon programs of general interest to scientific men, uniting in many cases the common fields of several sciences. This convocation week meeting must be held in a large city and its work must be largely technical. But there appears to be ample room for smaller and less formal meetings in the summer, held in a university town or summer resort, where those who liked—and many teachers and others whose work in science is somewhat that of the amateur would appreciate the opportunity—could come together. Out-of-door life and scientific excursions would there be possible, pleasant and profitable.

A full discussion of the whole problem of scientific organization would be opportune and useful at the present time. This journal will be glad to give space to those who are willing to express their views on the subject, and we hope that it will be discussed from different standpoints.

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## *SOME RECENT PHASES OF THE LABOR PROBLEM.**

### OLD PROBLEMS, BUT NEW CONDITIONS.

In the rapid development of modern industry old problems are ever assuming new and perplexing phases, but intrinsically new ones rarely develop. Each age is quick to imagine that its difficulties exceed those which were conquered by its predecessors, and to fancy the latter as free from the obstacles in overcoming which the courage and genius of its own leaders are subjected to their supremest tests. But this is the superficial view only. Just as the principle upon which the most complex mechanism performs its marvelously specialized functions is to be found in the crudest labor-saving devices of the earliest dawn of culture, so the most primitive industrial organization, when subjected to minute scrutiny, is sure to present traces of those elements of friction, which, one after another in different stages of progress, become the particular and absorbing problems of generations to which each in turn seems the sole serious impediment to the realization of perfect conditions.

The labor problem is no exception. It is the struggle between different factors in production over the relative shares of each, and its origin lies deep in fundamental conditions which have existed as long as men have known the wisdom of saving labor by the use of tools and of conserving productive resources by the device of private property. It will persist, in one or another of its protean forms, until by some unlooked-for alchemy man learns to satisfy all human wants without requiring from any individual more labor or abstinence than he will voluntarily undertake. In every historic era this unceasing struggle has left indelible traces upon the record of man's progress, and rarely has it yielded the place of primary importance in the minds of men to anything less compelling than religious zeal.

### A PERSISTENT INQUIRY.

How shall the comfort of satisfied economic wants be divided between those who contemporaneously endure the physical discomforts of toil and those who control the other factors in production? This is the everlasting question which, in various forms, has been asked and answered, re-

* Address by the vice-president and chairman of Section I, Economics and Social Science, St. Louis meeting, December, 1903.

asked and answered again in unending repetition while humanity has struggled from the crudest forms of industrial organization, through slavery and serfdom, up to the wages system. It is asked to-day, when the share of the poorest who labors with his hands is sufficient to purchase comforts which a few centuries ago were beyond the reach of kings, and although the agencies which capital has established seek daily in the uttermost limits of the earth and among the most distant islands of the sea to bring thence and lay cheaply at the feet of labor every product that can satisfy or please, the final answer is not yet. Indeed, in this most fortunate land, where sturdy manhood has found nature in her most generous mood and industry and genius have won an abundant and increasing harvest, there is at this hour of highest prosperity a reverberating discontent which seems to some to menace much that has been gained.

The organized demand for a better answer to this persistent questioning than labor has ever yet received appeals strongly to the sympathies of those who love their fellowmen, and, as long as it is kept within reasonable bounds by a due sense of the responsibilities of strength and the rights of others, will have the aid and approval of the right-minded. But sympathy may go where sanction must be denied, and in every step of its perpetual struggle for what it rightly or wrongly conceives to be the interests of labor, and the means of attaining a higher standard of comfort and culture, the demands of organized labor must be subjected to intelligent scrutiny, and the probable consequences of granting them must be calmly and minutely examined.

### CONDITIONS OF THE PROBLEM OF DISTRIBUTION.

Let us enumerate a few of the fundamental conditions of this struggle over distribution. Capital is the great labor-saving contrivance and the mother of all labor-saving devices. Withdraw that which exists, and, with the most grinding toil, the earth could not be made to support a tithe of its present population. Stop its further accumulation, and industrial progress would cease until presently it should give place to retrogression. Remove the incentive to abstinence, and saving and accumulation would stop, while the gradual consumption of existing capital, not offset by replacement, would inaugurate a movement toward barbarism. Reduce the incentive, and the pace of progress will be proportionately slackened. But capital is not only the handmaiden of labor; it is the accumulated product of labor. Wherever it exists, it is conclusive evidence of previous effort and abstinence. Labor, alone, can pluck the ripened fruit; it can not increase the product by cultivation, for it can not subsist during the period of growth. Labor can wade in the stream and catch a few fish with its naked hands, but it can not spread the net to gather food for a multitude unless capital provides for its immediate necessities while the fabric is being constructed. Labor can carry an armful of coal or a stick of lumber, but the locomotive which hauls its train of fifty cars, each containing one hundred thousand pounds of coal or lumber, is capital. But the instruments of husbandry, the net, the locomotive, have no direct or final utility of their own. Of themselves, they neither feed, nor clothe, nor house the body of man, nor minister to his higher needs. They will not be brought into being, unless, for the effort expended in their creation, their producers are guaranteed a fitting recompense. This recompense must be a share in the products obtained through their agency and the economic name for this share is 'interest.'

Interest, including in that term compensation for the risk assumed, is all that capital, as such, ever obtains from production; it is the least which it will accept. It is high when the supply of capital is small in proportion to the demand for it, and low when the condition is reversed. Profit is not for capital; it is the wages of the usually arduous labor of determining the direction of industrial investments or the differential reward of exceptional economic foresight or technical skill. Those who reap profits are differentiated from those who receive wages by the fact that profits are dependent upon success (possibly it is better to consider that in the case of failure there are really negative profits), while wages constitute a preferred claim, the payment of which is usually arranged for in advance.

### THE LIMIT OF WAGES.

Here, then, are the conditions of the problem. Labor must have its wages at all times and under all conditions. In the long run directing efficiency must have its profits and capital must have its interest. Wages may often absorb portions of the shares of the other claimants, but unless these are eventually satisfied, the efficiency of industry will be impaired and capital will cease to accumulate, either because the owners of wealth prefer to consume it or because they hoard it rather than permit its use as capital on unsatisfactory terms. Thus is the limit of wages fixed. The efforts of organized workingmen to secure higher wages deserve approval so long as they do not threaten industrial efficiency through a reduction of interest or profits below the minimum limits respectively fixed by marginal capitalists and *entrepreneurs*. Demands that exceed these limits would, if granted, produce results which could only react unfavorably upon those who made them. The increase and progressive diffusion of industrial intelligence tend to reduce the amounts which can be effectively demanded by those whose service to society lies in determining the character and organization of productive efforts, and the rapid accumulation of capital tends to reduce the general rate of interest. Consequently, wage-earners can reasonably anticipate an increasing share of the value annually produced, and if, under favorable conditions, they fail to receive it they may justly demand a change in the proportion which they are accorded.

### WHY WORKMEN ORGANIZE.

The instinct which impels workingmen to organize rather than to deal separately with their employers is precisely the same as that which at other points of economic contact has universally led to efforts to mitigate the consequences of competition by the simple device of combination. The single workman, dealing with an employer of many workmen engaged to render similar service, is at exactly the same sort of disadvantage which confronts the small manufacturer who has to sell in a market to which a multitude of competing producers have access on equal terms. There is nothing strange in the fact that the characteristic movement of the great industrial revolution which has been in progress since the invention of the spinning jenny and the power loom has left its impress upon labor as well as upon capital. If labor had not organized, it would have been a sadly belated factor in the industry of the opening years of the twentieth century. Just as capital must continue to compete with capital, so labor will compete with labor as long as capitalistic production and the wages system endure, but on either side folly could go no further than to seek the perpetuation of the crude, cut-throat competition which seeks the immediate exter-

mination of the rival at whatever cost to the survivor. Such competition is crude in its methods; it is destructive in its consequences, and it is not, to-day, a means of attaining the highest degree of economic efficiency. Both capital and labor are amply justified in uniting to mitigate this kind of competition. It is to be observed, in passing, that the capitalistic combination, when fully justifiable, is the means of economies in operation and management which lower the cost of production, and in the face of actual or potential competition are always finally expressed in reduced prices. The labor combination has so far almost always lacked this justification, and the leaders must systematically seek it or their organizations must continue to find their entire economic basis in the mitigation of the evils of unrestrained and destuctive competition.

### THE EMPLOYERS' SIDE.

Enlightened employers do not expect or desire to obtain profits by securing the greatest aggregate of labor, measured in hours or effort, at the lowest cost. The American manufacturer has seen the greatest productive efficiency coincide with the highest wages, and he knows that the countries where workmen receive the lowest real wages are unable to compete in the markets of the world with those whose labor is better paid. He is able to estimate somewhat accurately the superiority of intelligent, well-fed, well-clothed, well-housed and contented workmen over those who do not enjoy similar advantages. He knows that every machine in his factory works better in the hands of those whose standard of living requires a high degree of comfort. Yet in the economic philosophy of American employers there is no place, and there should be none, for gratuities. High wages, liberal wages, are preferred not from any impulse of generosity, which would be out of place and destructive of its own purposes, but because, dollar for dollar, the return from high wages exceeds that from low wages. When this is not the case, it means that the point of over-payment has been reached. The excess of the wages received by the overpaid group, in such an instance, over the normal amount, is a burden which must be borne by the other industries and the other workmen of the same community. Each workman must give in labor a fair equivalent for what he receives in wages, or some other workman will receive less than he gives. The employer who, for the sake of continued peace during a period of high profits or for any other reason, aids in establishing such a condition, strikes a blow at industrial welfare which in the end will fall most severely upon the wage earners. It is not claimed that the practices of individual employers invariably attain to these standards. Narrow selfishness and unenlightened greed sway their proportions of the members of every industry and every grade in every industry. Employers have dealt grudgingly and even cruelly with workmen in far too many instances and always to their own injury. Yet the conditions which make for fair dealing are so compelling, even if we omit the paramount condition created by the force of public sentiment, and they are so easily read, that it is not too much to say that, in the main, American employers desire to deal fairly, and do deal fairly with the men whose names are upon their pay-rolls.

### HOW IT LOOKS TO UNIONISTS.

The economic philosophy of general acceptance among the members of labor organizations is not so easily grasped. Indeed, there is reason to believe that, except for a few generalizations of the broadest character, there is no economic creed to

which American trade unionists as a class adhere. Among their leaders, there is every shade of belief from the strong individualism of John Mitchell to the socialism of Eugene Debs. Even in the principles to which the various unions of the American Federation of Labor adhere, there is no uniformity, for we find organizations, like the United Mine Workers, which desire a monopoly of all labor engaged in certain kinds of production and move toward it by waging destructive warfare upon existing unions of more modest ambitions, side by side with others which admit only the journeymen workers of single highly specialized trades. Theoretical agreement is probably confined to the propositions that the share of labor in the products of current industry should steadily increase at the expense of the share of capital, and that this can be accomplished by the enforcement of collective bargaining. It is less surprising that the first proposition should be pressed by some to the extreme of denying the validity of the claim of capital to even the smallest share in the benefits following production than it is gratifying that the socialists, whose philosophical system rests upon this view, have made so little progress in their efforts to turn the labor movement into an organized demand for the socialization of all industry.

### DIVERGENT UNION METHODS.

Even in the current practices of unionism there is little uniformity. At their best, as exemplified in the recent history of some of the brotherhoods of railway employees, these practices tend to increase the dignity of labor and to simplify the relations between employers of large bodies of labor and the workingmen composing the latter. On the other hand, there have been instances in every great city and in most industries in which organized labor has been made the means of denying to American citizens some of the most fundamental rights of industrial liberty; of intolerable interference with public order, and of oppression, falling with equal injustice upon representatives of capital and of labor. What more significant contrast could there be than that offered by American unionism; one day paying tribute at the grave of P. M. Arthur, the conservative leader of a conservative organization, and, on another, parading under the leadership of a creature under conviction for using his position in a labor union as a means of blackmail and the grotesque figure of the man whose infamous name has became a synonym for the unspeakable vileness of the lowest period in the political degradation of the chief city of this country. Yet how short the interval between the funeral of the late Grand Chief of the Brotherhood of Locomotive Engineers and the Labor Day parade led by Parks and Devery.

### CONDUCT THE TEST.

I do not bring these facts to your recollection without a purpose. They are submitted as conclusive evidence of the gulf which separates the best organizations from the worst. Between these extremes are undoubtedly to be found representatives of nearly every intermediate degree. In fact, the same organization will not infrequently appear, within a short period, to be guided by utterly divergent ethical and economic principles. Such a lack of stability is of course unfortunate, but it is attributable to a cause that operates in all voluntary associations, and at times even in the state itself; absence of interest on the part of those whose influence, if exerted at all, would usually fall on the conservative side. The conclusion to be drawn from these facts is an important one. They establish the principle that every labor organization and every demand of a labor organization must

be treated, and ought to be treated, according to its independent merit. It is impossible to generalize far beyond the right of workmen to organize, a right which no sane student of industrial affairs and no intelligent employer of labor ever now disputes. Workmen have the right to organize and to do so on such terms and for such lawful purposes as seem good to them, but employers have an equal right to refuse to deal with organizations whose purposes or methods would lead to a loss in efficiency and to reject particular overtures whose acceptance would have that effect. Employers who earnestly desire to accord to a movement, the persistence of which against great opposition and in spite of enormous obstacles of internal origin, establishes the economic soundness of its central principle, will always strain a point in favor of dealing with labor organizations. Indeed, no employer ought to decide to refuse to consider an offer to make a collective bargain on the part of his employees except on the most convincing grounds and with the greatest reluctance. To destroy one labor organization is but to prepare the way for another, and the elimination of one set of labor leaders will never be more than the signal for others to enter upon the scene. Nor are the new organizations and the new leaders always to be preferred to the old.

FAIR TREATMENT FOR FAIR EMPLOYERS.

The character of a labor organization is to be measured by its acts and by the principles to which it adheres. The most common tests of character relate to the treatment of non-union men, restriction of output and the strike. Before any of these, but not detracting from their importance, I should put the attitude of the organization toward the fair employer. What objection can be raised to the declaration that neither a fair workman nor a just organization will enter into an agreement which may compel unfair treatment of a fair employer. Yet this principle, so obviously just, is openly and constantly violated by organized labor. Before the recent Anthracite Coal Strike Commission, witness after witness among those called on behalf of the striking mine employees, testified that prior to the great strike of 1902, he had no grievance against his employer, the Philadelphia and Reading Coal and Iron Company. This great company enjoyed an unimpeachable record for fairness to its employees, and among them there existed no doubt that should unintentional wrong occur it could readily be brought to the attention of its mining superintendent and would be promptly and completely remedied. The man who holds this position, John Vieth, has spent more than half a century in the anthracite mines, beginning as a day laborer. He knows the mines and the miners as probably no other man has ever known or can ever know them; his sympathies are broad; his manner, frank; his honesty, rugged; his fidelity to the industry and every man in it, impartial and unbreakable. The Reading company reduced the price of powder a full decade before its competitors; it established the sliding scale of wages; it never owned a company store; it long ago established an employees' insurance fund, and it pays its miners on the simple per-car and per-linear-yard systems. Yet the organizers, who were sent to the anthracite fields from Illinois in the early part of 1900, were able to induce the employees of the Reading to pledge themselves to an agreement binding them to desert their fair and generous employers whenever the miners in the northern and western anthracite regions should feel sufficiently dissatisfied with the wages or conditions in their fields to demand a general strike. This is precisely what happened in May, 1902. The satisfied employees of the Schuylkill region had no

desire to strike, but because the men of the other regions desired to do so, they consented to attack the prosperity of the company which had brought prosperity to them, and, with no grievance of their own, to strike a severe blow against American industrial stability. This action is typical of hundreds of instances in which the most generous fairness on the part of individual employers has failed to protect them against sharing the penalty of real or fancied unfairness on the part of the owners of other establishments with which they had no connection. In fact, with few exceptions, it is the current practice of American unionism to refuse any special protection to the employer who distinguishes himself from his competitors by the liberal treatment of his employees while, in a spectacular manner and with unbending spirit, visiting the sins of those who displease them alike upon the just and the unjust. Such a practice is destructive of the legitimate ends to be gained by organization. It places the generous employer at a greater disadvantage than that resulting from the ordinary competition of his rivals, and utterly destroys the business advantage that ought to go with righteous methods.

The principle which requires the fair treatment of fair employers must be established as a part of the creed of unionism before the latter can become a genuine means of industrial and social betterment. This would require the revision of some very prominent features of the methods now current among labor organizations; it would abolish the sympathetic strike and also the general strike which, in recent instances that all will recall, has frequently paralyzed the industry of entire sections. It would leave labor controversies to be settled by the parties directly concerned and would pretty effectually deprive both of the equally fickle support and opposition of public sentiment based on mere personal inconvenience and annoyance.

### TREATMENT OF NON-UNION MEN.

The attitude of many numerically strong labor organizations toward those workmen who refuse to join their ranks approaches closely to a denial of personal freedom in matters concerning which no liberty-loving individual can submit to dictation. No organization except government can, with the sanction of the intelligent and far-seeing, be permitted to demand allegiance. Yet many labor leaders declare that no workman has a moral right to remain aloof from their organizations, and compare those who dare to do so with those guilty of treason in its most repulsive forms. This doctrine has its natural consequence, during the stress of great strikes, in violence directed at the persons and property of those who give practical expression to their independence by retaining employment against the wishes of their fellows or by accepting positions abandoned by those on strike. It would be absurd to expect any other result. Idle men of somewhat limited culture, of violent passions and possessing a strong sense of the solidarity of their class, with abundant oportunities for the development of mob spirit, will always attempt to compel obedience to what they regard as the moral law when convinced that those who violate it are doing so to the positive injury of their class. Hence, when John Mitchell and other leaders in the great strike of 1902 proclaimed against violence, in the abstract, with one breath, and with the next compared the men who were at work to Benedict Arnold and to the tories of the Revolutionary period, they laid a foundation upon which it is not strange that other men, whose opportunities to acquire self-control had been more limited than their own, should erect a superstructure of

violent interference with the rights of others.

These leaders did not even verbally condemn the use of the boycott for the purpose of enforcing the new commandment: 'Without permission of the majority thou shalt not work.' It was invoked to drive the daughters and sisters of non-union men from employment as teachers in the public schools and in the factories, to prevent medical attendance upon the sick and to interfere with the interment of the dead. Its most common use was to deprive families of the necessaries of life, and fathers who sought work for the sake of their little ones were sometimes compelled to see them suffer from hunger because no one dared to sell them food. From this expedient to dynamite how short the step. No one need be surprised that it was repeatedly taken.

THE VOICE OF AUTHORITY.

It still remains to be seen whether those who have been most prominent in inculcating this new doctrine of the depravity of refusing to join an organization and especially of insisting on the right to work on terms which are unsatisfactory to others will learn wisdom from the Anthracite Coal Strike Commission and the President of the United States. To appreciate the contrast between their teachings and those of the great, extra-legal labor commission and the President who created it, it is necessary to compare certain expressions of Mr. Gompers and Mr. Mitchell with the later official utterances of the commission and the President.

Mr. Gompers is the author of the following:

> * * * The individual workman who attempts to make a bargain with the directors, or the representatives of such a directorate, simply places himself in the position of a helpless, rudderless craft on a tempestuous ocean. If he did but himself a wrong we might pity him and concede not only his legal but his moral right. But for the workman who toils for wages and expects to end his days in the wage-earning class, as conditions seem to point, it will be a necessity, his bounden duty to himself, to his family, to his fellowmen and to those who are to come after him to join in the union.

Mr. Mitchell's expression is, perhaps, still more forcible. He said of the non-union man who works during a strike that:

> He is looked upon, and I think justly, in the same light that Benedict Arnold was looked upon, or any traitor. He is a man that fails to stand for the movement that the people stand for, and, after all, the majority of the workers in any particular community reflect the public sentiment of that community. It is the movement of the people of that community, and if a man wants to desert his fellow workers and wants to prevent them from accomplishing good ends, then he is justly looked upon with disfavor by those who are right, because his working does not affect himself alone. If it only affected himself, it would be a different proposition, but the fact that he works helps to defeat the objects of the men who go on strike.

And then, answering the inquiry whether the 'lives of the wives and children' of the men he had thus condemned ought 'to be made unendurable,' Mr. Mitchell declared:

> I think those wives and children had better ask their fathers.

Both of the foregoing declarations constituted part of the record before the Anthracite Coal Strike Commission when it unanimously adopted a report containing the following:

> The non-union man assumes the whole responsibility which results from his being such, but his right and privilege of being a non-union man are sanctioned in law and morals. The rights and privileges of non-union men are as sacred to them as the rights and privileges of unionists. The contention that a majority of the employees in an industry, by voluntarily associating themselves in a union, acquire authority over those who do not so associate themselves is untenable. * * * It should be remembered that the trade union * * * is subordinate to the laws of the land and can not make rules or regulations in contradiction thereof. Yet it at times seeks to set itself up as a separate and distinct governing agency, to control those who have refused to join its ranks and to consent

to its government, and to deny to them the personal liberties which are guaranteed to every citizen by the constitution and laws of the land.

Finally, exercising the authority voluntarily accorded to it under the terms of the submission, the commission established the wise and salutary rule:

That no person shall be refused employment, or in any way discriminated against, on account of membership or non-membership in any labor organization; and that there shall be no discrimination against or interference with any employee who is not a member of any labor organization by members of such organizations.

It is very highly to the credit of organized labor that among the seven members of the tribunal which, without a dissenting voice, enunciated this fundamental principle of fairness toward all labor, sat the distinguished chief of the Brotherhood of Railway Conductors, probably the ablest of the living labor leaders of America, Edgar E. Clark. The last paragraph quoted has received especial presidential approval, having been quoted in full in President Roosevelt's letter of July 13 last to the Secretary of Commerce and Labor, in which it is followed by these words:

I heartily approved of this award and judgment of the commission appointed by me, which itself included a member of a labor union. This commission was dealing with labor organizations working for private employers. It is of course, mere elementary decency to require that all the government departments shall be handled in accordance with the principle thus clearly and fearlessly enunciated.

Thus in decreeing that every productive establishment of the federal government should be an 'open shop,' in which there should be no discrimination among American citizens on account of race or creed or membership or non-membership in any legitimate organization, the President in the plainest terms gave the weight of his endorsement to the sound doctrine that the discrimination thus forbidden in the workshops of the government ought not, anywhere, to be permitted. The freedom of American workmen could not survive the general abandonment of the 'open shop.' It is infringed whenever there is any discrimination such as can no longer exist in the government shops. Workmen who have faith in their own abilities, who treasure the liberties won for them by their predecessors here, who realize the spirit and the beauty of the Golden Rule, will not seek to debar others from the right to work on account of a disagreement as to the propriety of the terms and conditions on which work can be obtained. The 'union label' is one of the milder measures for compelling men to join organizations against whose principles or practices they wish to protest by remaining aloof from them. He who refuses to purchase goods not having this label is attacking the independence of some fellow-citizen. The employer who weakly assents to its use becomes a participant in a conspiracy against those workmen who dissent from the principles or methods of those who control the organizations in their fields. It is not pleasant to condemn a device which does afford some guarantee that the goods to which it is attached are not produced under oppressive conditions, but while giving partial protection against this danger the 'union label' threatens one of the most fundamental and sacred rights of every individual. Divest it of its proscription of the non-union man and its power for good will win for it deserved welcome from all right-thinking men.

### RESTRICTION OF OUTPUT.

There would be little utility in discussing the restriction of individual output in its theoretical aspects. That the practice is unsound in economics is recognized by all students and even by those leaders of labor organizations who are unable to deny that it is followed, more or less extensively, by the members of their organizations.

This general condemnation of the practice makes it extremely difficult to determine its extent, but no one doubts that in one way or another it is a characteristic of most unions. It can not, however, be said to have originated with them. Whenever two men work side by side, for an employer, there is a decided tendency to limit the labor of both by the capacity of the less skillful and energetic. As the number of workmen increases the tendency in this direction is inevitably strengthened, and while there may be some increase, through example and emulation, in the labor of those who would do the least if working alone, the net result is always expressed in an average that is much nearer the capacity of the least capable than that of the most efficient. All this will happen in any establishment without the aid of a labor union. What, then, is the consequence, in this connection, of organization? Usually its first effect is that the restriction which was formerly tacit and somewhat irregularly enforced is reduced to a set of definite regulations that are systematically enforced. It may not become greater in amount, although it is not unlikely that it will. There is some evidence, however, that the improved economic perception on the part of labor leaders is causing the older organizations to abandon their efforts in this direction. Yet the recent growth of the unions in numbers and power, and the reluctance of employers to resist their aggression in this particular, during a period of such tremendous general prosperity that nearly every productive establishment was taxed to its utmost capacity, have unoubtedly led to an extension of the practice of restriction which must be checked. The unit of production per employee per hour has suffered a very considerable decrease in almost all American industries during the last six or seven years, and this diminution of effectiveness has placed a more severe burden upon industry than the enhanced wages by which it has been accompanied. The record of the United Mine Workers in the Anthracite region is probably an extreme one, but it can be more advantageously studied than any other on account of the elaborate investigation prosecuted last year. The testimony taken by the Strike Commission contained instances of probably every conceivable method by which the output of a body of workmen can be kept down to the level fixed by the least able and industrious. Those who dared to rebel against rules restricting their earnings were subjected to the ill-will and the systematic oppression of their less intelligent and energetic comrades, until they either became less efficient or were driven from the mines. It is necessary to be patient with folly that springs from ignorance, but there is little excuse for leaders who, knowing the truth, do not use all their tremendous influence to spread an intelligent understanding of the simple economic principles which would at once destroy this most vicious of self-limiting practices.

### STRIKES.

That recourse to the strike should ever be necessary is wholly deplorable, but the condition of men whom the laws deprived of the use this industrial weapon of last resort would be indeed pitiable. Freemen must have the right to work and the right not to work, and they may not be impelled to choose the former by any command more imperative than that springing from their own desire to enjoy the fruits of exertion. The whole fabric of industry and commerce rests on bargains toward which there is no compulsion stronger than this. Between the buyer and seller of commodities there are successive offers and counter-offers until a point acceptable to both, but less satisfactory to either than his orig-

inal demand, has become the point of contract. The corporation and the 'trust' do away with a great deal of dickering between individuals, and in a precisely similar way the labor organization attempts to substitute a single collective bargain for a multitude of individual bargains. If, however, the corporation and the trust are unreasonable in their demands, every one now knows that the potential competition of smaller concerns, which always exist, is speedily actualized and the productive organizations that have shown their commercial incompetence to bargain reasonably with buyers are destroyed. So it should be with labor organizations. Those organizations which are reasonable in their demands will usually establish their right to survive by remaining at peace with the employers; those whose frequent strikes and repeated complaints of the alleged tyranny of employers prove their inability to bargain are usually inefficient in their efforts to promote the interests of their members and ought to pass out of existence. Yet the decision as to the terms which they will accept must always be left with the workmen, organized or unorganized. The right to strike ought to be used rarely and reluctantly; its use should always throw the burden of justifying its course at the bar of public sentiment jointly upon the employed and the employer; it can never be necessary except by reason of the grievous fault of one party or the other: yet it may be necessary and the greatest protection against its becoming so, save that which lies in the development and spread of a broad and intelligent spirit of humanity, lies in its exceedingly careful preservation. Generally speaking, however, the union which strikes on small provocation and frequently is to be classed among those which are undesirable, and the credit of any labor organization ought to be in inverse proportion to the frequency of its resort to this extreme method of enforcing its demands.

As somewhat justifying the assumption that every strike is evidence of lack of capacity somewhere, and perhaps indicating where the blame more frequently resides, I would call your attention to the very large number of strikes which always attend the transition from a period of great industrial prosperity to one of relative depression. The interpretation of this phenomenon is very simple. From almost the beginning of a period of prosperity the leaders of organized workmen perceive that their position is one of growing strength. The demand for products is a demand for labor, and as the one is expressed in rising prices the other is naturally translated into rising wages. Organizations formulate their demands, make them, and they are granted. New demands and new concessions follow in an alternation which becomes more rapid as prosperity appears more intense, the willingness of employers to grant even seemingly extravagant demands as to wages or conditions being based on a confidence in the continuance of heavy demand and high prices which often amounts almost to intoxication. While this process has been going on the effect of high wages and reduced efficiency is being transferred to the consumers, always with some addition to make up for the exactions of those in charge of production. Naturally, this can not continue forever. Sooner or later there is a consumers' 'strike.' That is, high prices ultimately reduce the effective demand, orders come less freely, the bubble is about to burst. Employers rather promptly perceive the situation more or less clearly; labor too frequently does not. More wages or less work, or both, are again demanded, and, as this time the employers see that the cost of acquiescence can not be shifted or realize that a curtailment of pro-

duction must soon occur, the demands are refused. The strike which, if the workmen are ill-advised, follows, marks the turning point from prosperity to depression.

The other typical strike is a protest against a reduction in wages when the decline in commercial activity is in progress, or before the change to perceptibly better conditions has arrived. Such strikes are less frequent but much more likely to be creditable to the judgment of the strikers. Employers rarely refuse reasonable demands while industry is prosperous and the labor market empty or nearly so; some of them do attempt oppressive reductions in wages or unjust modifications in conditions when the times are dull and the labor market glutted with the unemployed. This is not to say that radical reductions in wages may not be necessary; they are very apt to be after such a period of unprecedented activity in every line of industry as that which is but just closed or closing, but it should be recognized that when due allowance for the changed conditions has been made everywhere there may be some employers who will endeavor to take advantage of the situation and to deal unjustly with their workmen. May the number of such employers be few and the resistance of their employees wise, fearless and effective.

OTHER TESTS.

The character of any labor organization is further to be tested by its principles and practices in reference to labor-saving machinery, profit sharing, pensions, insurance funds, home ownership by its members, admission of applicants for membership, apprentices, the boycott, the manner in which it conducts itself toward other unions, and its rules and general policy. The verdict of intelligence concerning most of these matters is so clear that discussion would hardly be warranted. A wise policy will prevent any labor union from discouraging the introduction of improved machinery, from refusing to accept or opposing fairly formulated efforts of employers to obtain greater loyalty from employees, from counseling against the ownership of homes, from upholding the boycott, from preventing the industrial education of intelligent youth, and from permitting controversies with other unions to interrupt work or occasion inconvenience to blameless employers. That particular organizations have grievously erred in these matters is, perhaps, much better known than that some have stood steadfastly for sound principles.

These defects in the current beliefs and practices of some prominent labor organizations have been pointed out in no spirit of intolerance. The evils are widespread and serious; they must be plainly pointed out and bravely overcome; but they are not necessary accompaniments of such organizations. In fact, as to most of them the history of several highly successful unions can be cited to show that among organizations composed of the most intelligent workmen they are likely to be eliminated. It is even more true that the much less pardonable practices which involve blackmailing employers and combinations with unscrupulous representatives of capital to rob consumers and destroy competitors are merely temporary consequences of an early recognition of strength which is not restrained by a sobering consciousness of responsibility or by ability to perceive the consequences of such injustice.

VALUE IN ORGANIZATION.

The conclusion is that while the labor problem must always persist, the organization of labor will continue and will increase its power to be of service, not only to workmen but also to society. The principle of organization will not only survive the defeat and destruction of those organi-

zations which obstinately adhere to vicious principles and practices, but the genuine progress of the labor movement will be substantially advanced every time such deserved defeat is administered.

ARBITRATION.

While this progress is being made toward the atttainment of better things and substantial results are awaited, the public properly searches for a means of preventing or mitigating the annoyances and losses that spring from the interruption of production caused by labor conflicts. Until employers and employees learn such sweet reasonableness in bargaining together as to avoid strikes how shall their number and their evil consequences be reduced? Obviously the demand is for a temporary remedy for a difficulty which ought ultimately to disappear. With this fact kept carefully in view it is safe to consider the remedy of arbitration. This has actually but one form. To be arbitration at all it must be wholly voluntary. The term compulsory arbitration is self-contradictory, and however it may be disguised it really means the creation of a new type of court endowed with authority to make contracts relating to labor services. Arbitration—voluntary arbitration—is a term so grateful to the ear to which it comes as a substitute for the clash of bitter industrial struggles that it seems ungracious not to commend it without qualification. If men can not agree what can be better than to submit their differences to the settlement of a disinterested and impartial third party? *If men can not agree.* This qualification begs the entire question. Reasonable men can agree and unreasonable men must become reasonable or be replaced, in industrial affairs, by those who are. One way in which unreasonable men arrange for their own replacement is by getting themselves into situations out of which they can not be extricated except through the assistance of others. The adjustments of industry are too delicate to endure, without injury to all concerned, the frequent interference of the disinterested. A strong personal interest is the element which is most effective in preventing irreparable mistakes. Arbitration may be the smaller of two evils, but no one should fail to recognize it as an evil. Aside from the fact that it leaves the determination of matters of primary industrial importance to persons who will neither gain nor lose by the success or failure of the industry, it is evil in its consequences, because, when there is reason to rely upon its being arranged for, that fact constitutes an incentive to making, and insisting upon, unreasonable demands. The easy-going policy which consents to the submission of questions vitally concerning the welfare of an enterprise to persons who have no stake in its success naturally leads to the easy-going method on the part of arbitrators which is expressed by 'splitting the difference' between the conflicting demands of both of the contending parties. This is the almost uniform result of arbitration. If you will turn to the decision and award of the recent Anthracite Coal Strike Commission you will find that that ablest and most impartial of arbitration boards was not able to avoid this nearly inevitable result. In its pages you will read the contradiction of every substantial averment of the striking mine workers. You will find that the wages of the employees of the anthracite operators did not, in April, 1902, compare unfavorably with those of bituminous miners or men in other employments of similar character. You will find that the conditions of life and the standard of living in the anthracite counties of Pennsylvania were not lower than in comparable regions. You will find that the basis of payment was not unfair to the workmen.

You will find the United Mine Workers described as a body too strongly influenced by bituminous coal interests to be a safe factor in the anthracite industry. You will find that boys voted at its meetings and gave a reckless tone to its management. You will find that the period of the great strike was one of lawlessness and violence, which the leaders of the organization could not or, at any rate, did not effectively check. So much the gentlemen of the commission gathered from unimpeached and unimpeachable testimony, and so much they clearly, concisely and fearlessly set down in the permanent record of their arduous and graciously accepted task. But after bravely announcing these facts in terms quite equivalent to declaring that the strike had no justification, the commission yielded, as any other arbitrators would have yielded and as nearly all arbitrators will yield in future controversies, to the impulse, commendable in itself, to deal generously with those who have relatively little and awarded a general advance in wages.

### 'COMPULSORY ARBITRATION.'

The term compulsory arbitration in the literal sense of the words is a verbal absurdity, but it refers to a definite idea and one fairly understood by all. Those who favor it urge that when men will not reasonably agree on a contract relating to wages or other conditions of employment, and will not agree to let some third party make a contract for them, they ought to be compelled to adopt the latter course. The adherents of this view are very apt to begin their argument with the assertion that 'there are three parties to every strike'—the strikers, the employer and the public. They quite understate the number; there are five. There is, of course, always the public or rather the consuming public. Then on the side of labor there are always those, mistaken and misguided, perhaps, but American freemen after all, and entitled to that liberty under the law which has been described as 'freedom to do as you please and take the consequences,' who are willing to work on the terms rejected by the strikers; as well as those who have declined to work. On the side of capital, there may be supposed always to exist some one, over-sanguine, perhaps, but entitled to experiment as he would with his own, who would employ the strikers on their own terms; as well as the former employer. Compulsory arbitration shuts its eyes to both those willing to work for the rejected terms and those willing to become employers on the terms demanded. It sees only the old employers and the old employees, and would force them to continue the industry on terms very likely to be unsatisfactory to both. Manifestly, when this court of so-called arbitration has issued its decree containing the terms of a new labor contract, it must have some effective means for its enforcement. But by what process, consistent with freedom, is an employer to be compelled to pay wages that he believes must lead to bankruptcy, or employees to work on terms which they regard as so unjust that they prefer idleness to their acceptance? Such power is beyond the limits of governmental authority as they are established in the conditions essential to the preservation of human liberty. Men must be free to contract or not to contract, to work or to refuse to work, to remain in an employment or to leave it, to utilize their wealth as capital or to withhold it from the fields of production, to open their workshops or to close them, and there can be no limitation upon their rights in these particulars except as fixed by their own voluntary contracts, which does not dangerously reduce the liberties of the citizen. Public opinion may praise or condemn the manner in

which you or I exercise our legal rights and privileges, and in the face of it we may be driven to act otherwise than as we would. This pressure is legitimate, and when the public is not led astray by prejudice or wrongly instructed by demagogues the compulsion of its intelligent opinion often has salutary results. There can be no objection to this sort of compulsion, and if it leads to the arbitration of individual disputes, which would otherwise have caused prolonged and bitter strikes, it probably leads to the choice of the least evil of the available ways of escape from a condition too evil in itself not to result in some more or less permanent inconvenience. The difference between the compelling pressure of public opinion and the exercise of governmental authority is wide. If such authority is used by officers of a government to which power to compel arbitration has not been delegated, then that government has undertaken to over-ride its own laws, and regard for the law by the officers of government constitutes the whole difference between a despotic government and one which rests on the will of a free people. The humblest American citizen and the wealthiest American corporation are alike entitled to exercise every right which they possess under the laws which the people have made, and when any particle of the power or the prestige attaching to official position is used to curtail the liberty of either that of both is endangered. Public opinion may condemn a particular act which is not in violation of any law and, if unanimous and strong, it will usually be obeyed; but the hand of government must never be lifted to hasten the compliance. So long as the act is legal, government and the officers of government have no business with it. If the popular respect attaching to the most exalted office in the land has lately been made a means of compelling men to submit to arbitration the manner in which they shall exercise the rights which no one denies are theirs, there has been a misuse of official position and a precedent has been established which, if followed, will sooner or later seriously impair the quality of American liberty. Compulsory arbitration has been rejected by organized labor, and when Americans generally comprehend what is meant by that term they will have none of it whether through statutory enactment or by the unauthorized action of even the highest officer of their government.

THE OUTLOOK.

But if voluntary arbitration is no more than a temporary and rather dangerous makeshift, and compulsory arbitration is utterly to be condemned, what can be done? The answer has been given—men must learn to bargain together reasonably. The remedy ought to appeal to us more because it is a process and not a panacea for all the ills of industrial conflict. That men can learn to settle their disputes over wages without outside aid, and that unions can make and keep collective bargains, has been abundantly proven during the recent industrial experience of the United States. All that is required is that there shall be more of this reasonableness and much less of its opposite. That this will come with the growth and spread of intelligence there need be no doubt. When workingmen and employers scrutinize more thoroughly the conditions by which their relations are fixed they will appreciate the wastefulness of friction and will know that reasonable dealing and the observance of the Golden Rule constitute the best of all policies. In attaining this state of higher intelligence organizations of employees and of employers will bear an important and useful part. Whatever evils may be discovered in the current practices of either class of organizations, however absurd the doctrines or crude the practices of some of them, no

matter even how ill-advised their leadership, the contact of man with man which they directly cause, must, in the long run, lead to higher principles and better methods. Satisfaction with the distribution of the results of productive effort as between wage earners and capitalists, we shall not see. Probably, if we did see it, we should wish for a condition which gave more occasion for effort and more justification for hope. But while complete satisfaction with the proportions received is neither likely to be attained nor properly to be considered as entirely desirable, the time when much of the present friction shall have disappeared is already very clearly foreshadowed.

H. T. NEWCOMB.

## *THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.*

THE seventeenth annual convention of this association, held in Washington, November 17–19, 1903, was one of the largest meetings in point of attendance which has ever been held. Something over 200 delegates and visitors were registered, and the representation was very general from different sections of the country.

As has been customary for several years past, the annual meeting of the official horticultural inspectors was held during the days of the convention in conjunction with the meetings of the section on entomology.

The convention as a whole was notable for its harmony and the expedition with which business was transacted, and was remarked by many of the delegates as a most satisfactory meeting.

The address of the president of the association, James K. Patterson, of Kentucky, dealt with the general topic of the origin and work of the colleges and universities represented by the association, and the influences of these institutions upon the development of technical and industrial education.

One of the most important items of business was the consideration of the amendments to the constitution proposed at the Atlanta meeting. These amendments had been before the association for a year, and were adopted with practically no discussion. They provide for a reduction in the number of sections to two, one on college work and administration and the other on experiment station work, three members of the executive committee to be chosen by the first section and two by the latter. There is provision for each section to create such divisions as it may find desirable, but no such divisions have yet been made, and the report of the committee on the organization of the new section for station work recommended that for the present no such divisions be made. The section on horticulture and botany, however, expressed a desire to continue its meetings in the future, and appointed a committee to confer with the executive committee with reference to this matter.

The report of the bibliographer, A. C. True, called attention to the more important bibliographies which have appeared during the year, a list of 110 bibliographies with explanatory notes constituting the main part of the report. Special mention was made of the 'International Catalogue of Scientific Literature,' several parts of which have been noted in this journal. The incompleteness of this catalogue in regard to certain lines of work in agricultural science, notably that of the experiment stations, was a matter of much regret.

The standing committee on indexing agricultural literature called attention in its report to the index cards for the publications of the Department of Agriculture which are being prepared by the Department Library, and also to the cards for the accessions to this library. The latter are

now being printed by the Library of Congress, and can be obtained at small cost, as may also the catalogue cards of the Library of Congress relating to agriculture. The card catalogue of the Department Library now contains over 110,000 cards, and the library is thus in position to render more efficient aid than ever before to the agricultural colleges and experiment stations, by furnishing them information in regard to the literature on particular topics, loaning books, etc. Attention was called in this report to the combined index, now in press, to the first twelve volumes of 'Experiment Station Record,' and to the card index of agricultural literature issued by the Office of Experiment Stations.

The report of the committee on methods of teaching agriculture, presented by A. C. True, was on the relation of the natural sciences to agriculture in a four years' course, and presented a plan for a course of study including these natural sciences and noting in brief the principal subjects under each to be covered. The report pointed out that the older method of arranging the courses in agriculture tended to make experts in analytical or agricultural chemistry or in pathology, rather than to give a broad training in agriculture and the natural sciences. It was urged that there should be a sufficient period of general study before specialties are taken up, and that the paths of the specialist and the agriculturist should early diverge. The college course can not be expected to fit men for expert work in the Department of Agriculture, and the experiment stations, but for this work at least a master's degree and ere long the doctor's degree are likely to be required. This paper brought out much discussion, illustrating the marked interest which has developed within the past few years in the matter of courses of study and in agricultural education of different grades. The work of this committee was highly commended and was pronounced one of the most important features of the association's work.

The standing committee on agricultural engineering presented its first report through W. E. Stone, chairman. The report pointed out the increase in the number of engineering problems in agriculture and their prominence, the enormous extent to which agricultural machinery, and especially that of a complicated character, is being used by American farmers, the problems of irrigation and of drainage, the terracing of hillsides, the construction of roads and other topics, as illustrating the desirability of more systematic attention to instruction in these topics in connection with the college courses, and of extended scientific investigation. The courses in rural engineering in the colleges, it was stated, have not kept pace with the progress of the times. The committee declared in favor of separate departments of rural engineering in the colleges, the enlargement of the work of the Department of Agriculture to include agricultural engineering in addition to irrigation, and recommended that the executive committee of the association aid in securing the increased appropriation asked from congress for this purpose. This report was adopted, as was also a resolution commending the work of the Department along the lines of irrigation. The report brought out considerable discussion and indicated that this matter is occupying the attention of a number of institutions at this time.

The report of the committee on cooperation between the experiment stations and the Department of Agriculture, presented by E. A. Bryan, called attention to the statement of fundamental principles embodied in the two previous reports, expressed gratification at the appointment of a committee within the Department of Agriculture for perfecting the details of a

system of cooperation, and reiterated its belief that a full and free consultation between the stations and the members of the department forces in regard to the work undertaken in the several states is very desirable and would do much to remove possible sources of friction.

The standing committee on uniform fertilizer laws, of which H. J. Wheeler is chairman, called attention to the satisfactory progress which is being made in the direction of greater uniformity, the recommendations of the association having been of value in securing the recent passage or amendment of fertilizer laws in Indiana, Florida, Missouri, Pennsylvania, Tennessee and other states. This report also included recommendations concerning the laws for feeding stuff inspection.

The report of the standing committee on pure-food legislation, made by W. A. Withers, noted considerable progress along the line of pure-food legislation during the year. New legislation was enacted in two states, and provisions made by congress for the inspection and control by the Department of Agriculture of foods imported from foreign countries. This was pronounced an unusually important step in food legislation, and its execution has resulted in considerable progress in the preparation of standards of purity.

The farmers' institute work which the Department of Agriculture has taken up was outlined by A. C. True, who stated clearly the policy of the department in regard to this work. There will be no attempt to interfere with the state management of farmers' institutes in any way, but rather to cooperate with the state officials and to aid them in building up the institutes in the several states. The department will be a general agency for coordinating and strengthening this work throughout the country. One of the main objects at present is to help to increase the efficiency of the institute lecturers, now numbering over 800, less than half of whom are connected with the work of the colleges or the stations. A corps of specially trained institute workers was recommended as eventually desirable, to relieve the college and station men of much of the burden of this work, as it is the opinion of the department that the prime object of college men is to teach and of station men to investigate. The speaker pointed out the greatness and importance of the farmers' institute enterprise as a means for the future development of agriculture, of building up of a proper system of agricultural education and research, and developing a generation of farmers who will be in a position to appreciate and apply the results of the work of these institutes.

The following officers were elected for the ensuing year:

*President*—W. O. Thompson, of Ohio.

*Vice-Presidents*—D. F. Houston, of Texas; J. C. Hardy, of Mississippi; J. H. Worst, of North Dakota; H. J. Wheeler, of Rhode Island; and B. C. Buffum, of Wyoming.

*Secretary and Treasurer*—E. B. Voorhees, of New Jersey.

*Bibliographer*—A. C. True, of Washington, D. C.

*Executive Committee*—H. C. White, of Georgia; G. W. Atherton, of Pennsylvania; J. L. Snyder, of Michigan; W. H. Jordan, of New York; and C. F. Curtiss, of Iowa.

*Section on College Work and Administration*—Chairman, W. E. Stone, of Indiana; secretary, G. E. Fellows, of Maine; committee on program, W. E. Stone, of Indiana, G. E. Fellows, of Maine, and H. W. Tyler, of Massachusetts.

*Section on Experiment Station Work*—Chairman, E. H. Jenkins, of Connecticut; secretary, M. A. Scovell, of Kentucky; committee on program, J. H. Shepperd, of North Dakota, B. W. Kilgore, of North Carolina, and M. A. Scovell, of Kentucky.

In the meetings of the sections the most important papers and discussions were those on soil fertility, animal breeding, instruction in horticulture and botany, problems of forest entomology, methods of work in

economic entomology, the mission of the land-grant colleges and short courses.

E. W. Allen.

U. S. Department of Agriculture.

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## SCIENTIFIC BOOKS.

*The Lower Devonian Fishes of Gemünden.* By R. H. Traquair. Transactions of the Royal Society of Edinburgh, Vol. XL., Pt. 4, pp. 723–739, pls. 7, 1903.

Dr. Traquair's recent paper will be welcomed as throwing light on *Drepanaspis,* one of the lowliest vertebrates. In earlier papers Dr. Traquair has briefly referred to this armored form, known only from the lower Devonian slates of Rhenish Gemünden: in the present memoir he completes his studies upon it, basing them upon a remarkable series of the fossil which he has collected during the past dozen years.

Gemünden fossils, one may note incidentally, are remarkable for the great beauty with which their external characters have been preserved, shown especially in mollusks, trilobites and starfish; and the armored fishes have proven no exceptions to the rule. The specimens however, are always pyritized and are therefore, unfortunately, valueless for histological study. Besides *Drepanaspis,* the only armored fish known hitherto in detail from this horizon, Traquair now describes a *Coccosteus,* a *Phlyctænaspis* and two forms *insertæ sedis.* Of these the first, *Gemündina,* is a fish somewhat ray-like in form, characterized by a stout vertebral column and an integument well encrusted with shagreen denticles. What it is no one can say, although its describer regards it as 'possibly a chimæroid,' admitting, however, that his idea 'rests more upon feeling than upon anything else.' Until, therefore, more and better material can be secured one is constrained to conclude that nothing further need be said about its affinities. *Hunsrückia,* the second problematical form, is represented only by a series of vertebral arches whose structures suggest very doubtfully a pleuracanth shark. Regarding *Drepanaspis* the paper gives many interesting details, and they do not, we find, lead the author to alter his earlier opinion as to the affinities of this form. He places it near the classic *Pteraspis,* and regards it as the more generalized, a view which will probably meet general acceptance. It is a source of satisfaction to students of these earliest chordates that in the present form both dorsal and ventral sides are now known with fair accuracy. Desirable, none the less, is a better knowledge of the region of the mouth, which is practically terminal, surrounded by a rather indefinite series of dermal plates, and of the lateral angles of the body, where possibly an opercular opening is situated. And while we are duly grateful to Dr. Traquair for his skilful and continued efforts to elucidate this remarkable form, we are none the less impatient for further details. The object is, at the best, difficult to orient, and as a symptom of this it may be doubted whether the interpretations of even an author of Dr. Traquair's experience and acumen are always valid. Thus, his grounds seem inadequate for distinguishing dorsal and ventral sides. In no specimen figured is the relation of the dorsal lobe of the tail shown convincingly to be continuous with the so-called dorsal aspect; moreover, the eyes occur on the side which Traquair regards as ventral. Unless additional evidence is forthcoming, it would accordingly seem to me more probable that the 'labial' of Traquair was the 'rostral' plate, a structure which appears constant in *Heterostracans.* This interpretation would permit the eyes to be seen at the sides of the dorsal armoring, as indeed, they occur in *Pteraspis,* and would enable us, at the same time, to locate the greater number of the larger plates on the dorsal side. This conclusion is the more satisfactory on comparative grounds, since there is not an instance in the chordate phylum in which the eyes and the most complete part of the armoring appear on the (morphological) ventral side. And I doubt whether, on the present evidence, we can assume, with Professor Patten, that *Drepanaspis* might have evaded the law of vertebrate orientation by swimming on its back. Dr. Traquair has attempted to solve this dorso-ventral difficulty by suggesting that either the orbits are 'sensory' pits, *i. e.,* not orbits, or

that, 'since the specimens are all crushed absolutely flat, it is by no means certain that in the original uncompressed condition the openings did not look out to the side.'

Bashford Dean.

*First Report on Economic Zoology.* By Fred. V. Theobald, M.A. London. 1903. Pp. xxxiv + 192.

Under the above heading F. V. Theobald, a high authority on economic entomology in Great Britain, has published, under the auspices of the British Museum (Natural History), in three parts, his initial report of economic zoology. The volume in question is preceded by an introductory chapter of some extent by E. Ray Lankester, consisting of a classification of animals from the point of view of economic zoology. The same writer has added considerable correspondence on the dreaded tsetse fly disease of Africa, termites or white ants and the locust plague of the same country, as well as other matters not pertaining to entomology. Mr. Theobald is well known from his valuable treatise on the Culicidæ of the world, which has already reached the fourth volume. Although the main portion of the report is devoted to injurious insects and to other economical entomological questions, there is also frequent mention of the injury accomplished by mammals and birds and other pests as well as of fungous and other diseases. Much valuable information is furnished in regard to the means of preventing insect losses, a considerable proportion of which has been derived from actual experience or from reports of trustworthy persons. The work is not only of special interest and value to persons engaged in agriculture in Great Britain, but also to those of nearby countries in Europe, where many of the same species occur, although not always in the same degree of abundance. Many of the species considered are cosmopolitan, while others are common to North America and Europe, which makes the work also of interest to farmers of the United States. Among the most interesting species treated are the following:

The bud moth (*Hedya* (*Tmetocera*) *ocellana* Fab.), a well-known pest in the northern United States; the mussel scale, or, as it is more familiarly known in America, oyster-shell bark-louse (*Mytilaspis pomorum* Bouché), the pear leaf and 'big bud' mites. Among potato pests is a species of caterpillar, *Hydrœcia micacea,* which works in the same manner as our stalk borer, *Hydrœcia nitela* Say, well and unfavorably known to potato growers in the United States. Frequent mention is made of injury by millipedes attacking potatoes and other useful crops.

Considerable attention is given to the occurrence of the Colorado potato beetle in England, more especially in Tilbury, where it has been established for some little time. Judging by this report of local occurrence, it would not seem difficult to stamp out the pest in that region so as to prevent its spread to other portions of the country and eventually to the continent of Europe.

The so-called leather jackets or maggots of the crane flies or daddy longlegs (Tipulidæ) are considered somewhat at length. Records are cited of injury to hundreds of acres of grass land by these insects, and it seems probable that much injury is done by related species (of which there are many) in the United States, which is undetected or attributed to other forms of insects.

There is always danger of introducing European species into America, and it is singular that some of the commonest pests of England have never found a complete establishment with us, for example, the thousand-legged worm or millipede, *Polydesmus complanatus,* which has undoubtedly often been brought to this country in soil and has been mentioned as occurring here, but which our authorities state has not gained a permanent foothold. The same is true of the ear wig, *Labia minor,* which is said to be a pest in Europe, well established in America, but never injurious, so far as we know, in our own country. Another species frequently found in old buildings, in furniture and in old wood generally and commonly called death watch, *Anobium domesticum,* is in the same category, having undoubtedly been brought here in wooden material but, for some unknown reason, failing to survive. Mr. Theo-

bald's work concludes with an appendix which includes a list of North American locusts and a list of African termites.

F. H. Chittenden.

### INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE. GEOLOGY.

In looking over the reviews that have appeared of the various parts of the International Catalogue of Scientific Literature thus far issued for the year 1901, it is evident that those which are extremely critical have been written by men who are largely investigators. The men who have spent days in the laborious work of going over publications, writing out the titles of papers and arranging them according to a predetermined subject classification are certainly more generous in their commendation.

The publication on geology is probably as satisfactory as any of the others. Its greatest weakness for the purposes of the whole body of geologists is that of omissions and the limited scope of the subject classification. Many papers that have been omitted appeared in publications that have not been examined. But the character of the publication to be examined was limited by instruction concerning which the workers had no voice.

The scope of the subject classification is one of very great importance to the working geologist. The mass of geological literature is so large that he no longer burdens his memory with the fact that certain persons wrote upon certain topics about such a time and in such a place. Modern methods demand that these papers be brought together under suitable headings and that these shall be sufficiently detailed in scope to meet the needs of the investigator. The geological classification as it exists falls far short of filling this demand. This is not the fault of those who have prepared this bibliography, but the value of the publication under consideration would have been greatly enhanced if many papers had been brought out under more of the headings which were given them. This is due to the fact that probably much of this work of examining the literature was performed by persons who had no special knowledge of the subject, the literature of which they were classifying. This work to be well done—and no other sort of bibliographic work is acceptable—must be performed by those who have a considerable intimate knowledge of that portion of science which they are indexing. It is well known that some of those who participated in the formation of this organization were of the opinion that this work of classification could be executed by persons having a good general scientific education. The first annual issue of the bibliographies illustrates how erroneous is such a conclusion. If the preparation of the material by each of the regional bureaus were complete and satisfactory, the work of collecting and unifying them into a whole must be one replete with difficulties.

It is not the purpose of this notice to point out particular errors of omission or commission or to note defects in a spirit of hostile criticism, but to indicate what is fundamentally inadequate with the hope that in due time it will be rectified. It may prove to have been a wise determination to carry on this work for a period of five years before holding a congress at which these questions of revision will be discussed and determined. But it is believed that a higher grade of bibliographic work would result if a larger measure of discretion had been given to the central bureau. The difficulties which attend the inauguration of such a peculiar work are, indeed, great, but they must be overcome, if the organization is to be permanent and the outcome of its labor to meet the approbation and support of those for whose benefit it is conducted. For the present the following suggestions are offered to those who have in charge the preparation of these bibliographies.

1. Secure the assistance of specialists as far as possible. Would it not be practicable to send to such persons a list of current periodicals, publications of societies, etc., to be examined for each regional bureau, and assemble and unify their work for transmission to the central bureau?

2. Enlarge the list of publications examined to include those which only occasionally publish articles which should be entered.

3. Classify in greater detail. Enter a paper under each subject heading of which it treats even though it seem unimportant.

F. B. WEEKS.

## SCIENTIFIC JOURNALS AND ARTICLES.

THE *Bulletin of the Michigan Ornithological Club* for December contains articles on the 'Nesting of the White-breasted Nuthatch,' by Edwin G. Mummery; 'Purple Martin Notes from Waynesburg, Pa.,' by J. Warren Jacobs; 'Nesting of the Sandhill Crane in Michigan,' by Edward Arnold. There is the third series of portraits of Michigan ornithologists and other illustrations, including a half-tone of the University of Michigan Museum. Besides the papers above mentioned and the official 'Minutes of Club Meetings,' book reviews and the constitution of the organization there are numerous notes including 'Another Parasitic Jaeger (*Stercorarius parasiticus*) from Michigan,' by Alexander W. Blain, Jr., and 'Nesting of the Cardinal Grosbeak (*C. cardinalis*) in Ingham County, Michigan,' by Professor Walter B. Barrows, being the first authentic record of the breeding of the cardinal in the state. Beginning with 1904 Charles E. Wisner, of Detroit, will assume the business management of the *Bulletin*.

## SOCIETIES AND ACADEMIES.

### NORTH CAROLINA SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE seventh annual meeting of the section was held in the chemical lecture room of the Agricultural and Mechanical College, West Raleigh, on November 28, 1903, at 11 A.M., with presiding officer, Chas. E. Brewer, in the chair.

Preceding the presentation of papers a short business meeting was held and the following officers were elected for the ensuing year:

*President*—Dr. A. S. Wheeler, Chapel Hill, N. C.
*Vice-President*—Dr. R. W. Page, Raleigh, N. C.
*Secretary-Treasurer*—C. D. Harris, Raleigh, N. C.
*Councillor*—Professor W. A. Withers, Raleigh, N. C.
*Reporters*—W. G. Morrison, West Raleigh, and S. E. Asbury, Raleigh, N. C.

The following papers were presented and discussed:

*Action of Ultra-violet Light upon Rare Earth Oxides:* CHARLES BASKERVILLE.

See *American Journal of Science*, December, 1903.

*On the Action of Radium Compounds upon Rare Earth Oxides and the Production of Permanently Luminous Preparations by Mixing the Former with Powdered Minerals:* CHARLES BASKERVILLE AND GEO. F. KUNZ.

Will appear in *American Journal of Science*, January, 1904.

*Phosphorescent Thorium Oxide:* CHARLES BASKERVILLE.

As previously shown, thorium dioxide is one of the two rare earth oxides (zirconium dioxide being the other) and the only radioactive one which phosphoresces with ultraviolet light. This method of testing was applied to different fractions obtained from the thorium dioxide by volatilization of the chlorides. The three fractions obtained varied as follows: The residue (containing the carolinium) is only faintly phosphorescent, due doubtless to the retention of some thorium. The crystalline sublimate is about ten times as phosphorescent as the original oxide, whereas the very volatile fraction (*weisser Dampff* of Berzelius) does not phosphoresce at all. The last-mentioned preparation contains a little thorium. The radio-activity is greatest in the residue and least in the volatile body. The name *berzelium* is proposed for this third fraction of thorium.

*A Simple Device for Illustrating the Periodic Law:* CHARLES BASKERVILLE.

The device consists of blocks cut in length according to the atomic weight, taking one half inch for hydrogen. The blocks are planed, presenting flat surfaces corresponding to the valency. The electro-positive and negative properties are indicated by painting blue or red. When these blocks are arranged in an ascending series according to their heights, the resemblance of the properties of the ele-

ments in the different families of the periodic law is strikingly presented.

*Upward Filtration and Its Application in the Determination of Crude Fiber:* J. M. PICKELL.

This is a rapid method of washing and filtering fiber by sucking the fiber (contained in a beaker) up against a linen filter which is stretched across the top of a small funnel, or better, across a 'carbon filter,' which is provided with a rim for this purpose. The time consumed in a filtration is usually a fraction of a minute, but in the more difficult cases, two, three, four and in rare cases, ten or fifteen minutes. In the few cases tested (cotton-seed meal, wheat bran) it was found to pass (and thus lose) 0.2 per cent. to 0.3 per cent. of solids, which a good thick, but slow-filtering asbestos (Gooch) filter took out. With cotton-seed meal, corn bran, wheat bran, rice chaff, ground corn cobs, peanut hulls, peanut middlings, it gave duplicates agreeing within 0.01 per cent. to 0.30 per cent. A detailed description of the apparatus and method will be soon published. It is thought that unglazed terra-cotta disks and with suitable protection, even filter paper, especially the *hardened* variety, may be substituted for linen, and the method applied quantitatively to difficult filtrations other than those of fiber. Experiments in this line are in view.

*The Constitution of Cellulose* (a report): ALVIN S. WHEELER.

A review of the literature on the subject up to date. The empirical formula of the reacting unit is $C_6H_{10}O_5$. The evidence favors a cyclic formula for the unit. The fact that the tetra acetate of cellulose is a normal ester shows that four oxygens are hydroxylic. The fifth oxygen is carbonyl oxygen and the behavior of cellulose clearly indicates the CO group to be ketonic and not aldehydic. Fenton and Gostling's production of $\omega$-brommethylfurfural from cellulose is exceedingly interesting in this connection. The provisional formula $CO < (CHOH)_4 > CH_2$ has many suggestions in it. The subject is a very complicated one.

C. D. HARRIS,
*Secretary.*

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION.

AT the regular meeting held on December 4 the section elected to the council of the society, Professors E. H. Miller and Virgil Coblentz, and Drs. Leo Baekeland, Hugo Schweitzer and Durand Woodman.

The following papers were then read:

*The Dissociation of Lead Nitrate:* LEO BAEKELAND.

Dr. Baekeland described the methods and results of an extended investigation of the dissociation of lead nitrate under different conditions and discussed the principles of chemical dynamics involved in the interpretation of his results. Several pieces of apparatus especially designed for this research were described and illustrated.

*On the Conversion of Lead Sulphate to Barium Sulphate and a Method for the Determination of Sulphur in Lead Slags:* E. H. MILLER AND J. F. THOMPSON.

This paper showed that the conversion which would be expected from the difference in the solubility products of the sulphates could not be made to take place, as the mechanical coating of the lead sulphate by barium sulphate or a barium lead sulphate always prevented complete conversion. By varying the procedure and dissolving the lead sulphate in hydrochloric acid, a satisfactory precipitation of $SO_4$ ions as barium sulphate was obtained. This was made the basis of a method for sulphur in lead slags. A variety of slags were tested in comparison with the Fahlberg-Iles method.

*The End Products of Self-Digestion of Animal Glands* (first communication): P. A. LEVENE.

Dr. Levene gave the results of experiments with the pancreas gland and the liver. The pancreas was subjected to self-digestion in a 0.5 per cent. sodium carbonate solution, the liver in a 0.2 per cent. acetic acid solution. The present report covers the examination of the end-products for amino-acids. Alanin, amino-isovalerianic acid, leucin, glutamic acid, phenylalanin and tyrosin were found in each case. The presence among the digestion

products of $\alpha$-pyrolydin-carbonic acid could not be established with certainty.

*A Restant Source of Error in Optical Sugar Analysis:* F. G. WIECHMANN.

Dr. Wiechmann's paper dealt with the error due to the space occupied by the precipitate formed by basic lead acetate used as a clarifying agent. After a discussion of the extent of the error thus introduced in the examination of different classes of raw sugars, the author outlined briefly the results of a study of the methods proposed by Scheibler and by Sachs for the determination of the volume of the precipitate. This paper will be found in the *School of Mines Quarterly* for November, 1903.

*Dry Defecation in Optical Sugar Analysis:* W. D. HORNE.

Dr. Horne described a method for clarifying sugar solutions so as to avoid or minimize the error discussed by Dr. Wiechmann. The 'normal weight' of sugar is dissolved and diluted to 100 cubic centimeters and the solution clarified by the addition of pulverized anhydrous subacetate of lead. The acetic acid going into solution appears to replace in volume the organic acid, precipitated by the lead, so closely that the polarizations obtained on such solutions approximate the theoretical.

After the reading of the above papers, Dr. G. Plath, of Berlin, exhibited and explained a number of specimens of improved stoneware apparatus designed for use in chemical operations.

H. C. SHERMAN,
*Secretary.*

CHEMICAL SOCIETY OF WASHINGTON.

THE 146th regular meeting of the Washington Chemical Society was held Thursday, December 10, at 8 P.M., in the assembly room of the Cosmos Club. The program for the evening consisted of the following three papers.

The first paper, entitled 'The Bromine Absorption of Oils,' was presented by Mr. L. M. Tolman.

A comparison of the results obtained by different methods was made, and it was shown that the one third normal bromine in carbon tetrachloride gave as high addition figures as the Wij's and Hanus methods, when the carbon tetrachloride was dry and the reaction was allowed to take place in the light. Moisture was found to have a very marked effect on both the addition and substitution values. The length of time necessary to obtain complete reaction was found to vary in the light, 30 to 60 minutes being necessary, while in the dark a definite point was reached in a very short time, but the results were much below those obtained in the light. Experiments were reported using iodine chloride and iodine bromide in carbon tetrachloride solution. The iodine chloride in carbon tetrachloride was found to be the most satisfactory.

The second paper on the program, entitled 'The Action of Sal Ammoniac on Certain Chlorides,' was presented by Dr. P. Fireman. The action of ammonium chloride upon inorganic and organic polychlorides in sealed tubes at temperatures about 450° C. was investigated. The author found that those inorganic polychlorides which are themselves dissociable, react with ammonium chloride in a manner similar to the reaction between ammonium chloride and phosphorus pentachloride. With respect to organic polychlorides, it was found that under certain conditions carbon tetrachloride reacts with ammonium chloride, with the liberation of hydrochloric acid and the formation of a yellowish compound which is probably a polymeric modification of cyanogen chloride.

The third paper on the program, entitled 'The Solubility of some Slightly Soluble Phosphates,' was presented by Dr. F. K. Cameron. The author briefly reviewed the literature bearing on the solubility of the phosphates of calcium, aluminum and iron, and gave a preliminary announcement of some experimental investigations he has been carrying on with Dr. Seidell and Mr. Hurst. It appears that the evidence obtained can not be brought in harmony with the indications of the dissociation hypothesis, even in very dilute solutions. But some of the apparent discrepancies between the hypothesis and the observed facts are undoubtedly due to the fact

that these substances are very slightly soluble in themselves, but hydrolize greatly with the formation of a readily soluble constituent.

A. Seidell,
*Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 378th meeting was held on Saturday, December 12.

William H. Ashmead presented some 'Remarks on Japanese Hymenoptera,' stating that a recent study of specimens in the U. S. National Museum had raised the number of known species to over five hundred and fifty. Some of these were represented in eastern and southern Asia, while the relationship of the parasitic forms were largely North American. Specimens and drawings of some of the more interesting species were shown, including three distinct honey bees.

V. K. Chesnut and Harry T. Marshall gave "Some Observations on 'Locoed' Sheep." Mr. Chesnut described the symptoms of locoed animals; tendency to stray, loss of appetite for ordinary food, evident hallucination, outbreaks of violence, wasting of flesh and, finally, death. He stated that animals that had acquired taste for the loco weed rarely, if ever, recovered, and that in parts of the west the loss of stock was very considerable. The property of 'locoing' animals had been ascribed to various plants of the genera *Astragalus, Aragallus* and *Datura.* Mr. Marshall gave the results of the examination of fourteen sheep, afflicted with the loco-disease, and selected from a number as showing typical symptoms. These sheep exhibited no special lesions such as might be considered characteristic of the complaint, but some of them were infested by various parasites. The speaker stated that while he believed in the existence of a loco-disease so far as these sheep were concerned, the actual observations showed that it had been preceded by other causes and that sheep enjoying full health had not been attacked.

Charles Hallock spoke of 'The Bison as a Factor in the Distribution of Aboriginal Population in Mid-Continental America,' stating that the introduction of the horse had enabled the Indians of the southwest to follow the bison northwards into the plains, while as the country in the eastern United States became settled the forest Indians were crowded westward into the same localities, following the bison as a source of food. F. A. Lucas.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 351st meeting was held December 1. Dr. D. S. Lamb read a paper entitled 'Albinism and Melanism,' in which he carefully reviewed the contributions to the study of this subject. Dr. Lamb spoke of the wide distribution of albinism among human beings, its occurrence among animals and plants and of the experiments in the latter fields to produce albinism. Albinism, he stated, is congenital and inheritable. The theories on the cause of albinism were reviewed. The more important took civilization and the direct action of the nerves as causes. It was concluded that no satisfactory explanation of albinism and melanism has yet been advanced. In the discussion Dr. Hrdlicka showed photographs and samples of hair of the Hopi and Zuñi albinos and observed that there are more female than male albinos at Moki, that several are below the average intelligence and many were second child in order of birth. Dr. Hrdlicka expressed his belief in the causal relation of the nervous system to albinism. He related an extraordinary case where the wings of an albino jay bird which he cut off in Mexico had returned almost to their natural blue color when unpacked in New York. The president, Miss Alice C. Fletcher, said that housing among the different tribes accounted for differences of complexion and that albinism has been explained in this way. The secretary said that the purpose of the study of albinism and melanism from the anthropological side was to ascertain the causes of race coloration, which has been a fruitful subject for theorization. The discussion was taken part in by Mr. Hallock, Mrs. Lamb and Mrs. Seaman.

Colonel Paul E. Beckwith read a paper entitled 'The Rise and Decline of the Sword. Colonel Beckwith pictured the conditions of the life of early times and showed that man

had to weapon himself for his protection. Prehistoric flint weapons which stand at the beginning of the sword were exhibited and traced along to the seft of Egypt, down through the various derivative forms in Africa, Europe and Asia in the different periods. Colonel Beckwith described the sword blade, the nomenclature of its parts and the reasons for the different forms, closing with remarks on the decline of the weapon incident to modern warfare.

The question of the preservation of the antiquities of the United States, which was laid over from a former meeting, was brought up by Dr. H. M. Baum, who urged action. Professor Holmes said that the Bureau of Ethnology has taken up the subject and that Mr. McGuire is engaged in examining the laws of various countries with a view to the preparation of an act for the United States. Dr. Baum suggested that a movement be put on foot to awaken public sentiment in the preservation of antiquities and to this end the society should petition and put the matter before congress. Dr. Lamb moved that a committee of five members be appointed to consider and report on the ways and means for the preservation of antiquities. The motion was seconded by Mrs. S. S. James, who spoke of the work in this line by the ladies of Colorado. The president thereupon appointed a committee consisting of W. H. Holmes, J. W. Fewkes, A. Hrdlicka, H. M. Baum and J. D. McGuire.

WALTER HOUGH,
*Secretary.*

### BOTANICAL SOCIETY OF WASHINGTON.

THE sixteenth regular meeting of the Botanical Society of Washington was held at the Portner Hotel, December 5, 1903, with thirty-seven persons present.

The following program was presented:

1. *The Salt Content of Seabeach Soils:* T. H. KEARNEY.

Most writers upon the ecology of strand vegetation have implied, or even explicitly stated, their belief that the sands of the seabeach are impregnated with salt in amounts sufficient to determine the character of the plant growth. This hypothesis is not sustained by an examination of samples of dune and beach sand taken on the shore of Buzzards Bay, Massachusetts, near Norfolk, Virginia, and near Los Angeles, California. On the contrary, the amounts of soluble salt present, as determined by the electrolytical method used by the Bureau of Soils of the United States Department of Agriculture, is generally less than that found in most cultivated soils in the eastern (humid) part of the United States.

The greatest amount of salt detected in beach sand occurred in a sample taken at Los Angeles, California, which gave an electrical resistance (at 60° F.) of 158 ohms (equivalent to about 0.15 per cent. of salt to soil) for the first foot, and 180 ohms (equivalent to about 0.12 per cent.) for the second foot, an amount not greater than that sometimes occurring in cultivated land in the eastern United States. We are, therefore, constrained to attribute the xerophytic character of sand-strand vegetation to factors in the environment other than the presence in the soil of an excessive amount of soluble salt.

On the other hand, coast marshes that are regularly inundated by salt or brackish water possess a distinctly saline soil, and their vegetation may safely be termed halophytic, so far as halophytes may be regarded as forming an ecological class distinct from other xerophytes.

2. *The Influence of Climate and Soil on the Transmitting Power of Seeds:* WILL W. TRACY, SR. This paper will be published later in SCIENCE.
3. *The American Ginseng Industry:* F. V. COVILLE.

HERBERT J. WEBBER,
*Corresponding Secretary.*

### TORREY BOTANICAL CLUB.

AT the regular meeting of the club held at the College of Pharmacy, December 8, 1903, the scientific program consisted of a paper by Mr. W. L. Horne on 'The Vegetation of Kadiak Island, Alaska.' The paper was illustrated by a large number of botanical specimens and by numerous photographs showing the topography of the island and the characteristics of the different plant formations. Kadiak Island is 58° north latitude and 155°

west longitude and is thirty miles from the mainland. It is twenty miles long by fifty wide and has a very irregular coast line. The surface is much diversified and broken. A fresh-water lake about twenty miles long is situated in the northwestern part of the island. It is connected with the sea by the Karluk River and furnishes an ideal breeding ground for the red salmon. One of the most important fishing stations and canning plants in the world is located near the mouth of this river. The winters are very long, beginning early in October, but they are not intensely cold. The lowest temperature during the two years of Mr. Horne's stay was —10°. There is much mild weather and there are frequent thaws. The soil only freezes to a depth of from one to two feet, and the frost is out of the ground early in June. The highest summer temperature noted was 72°. The Chinese laborers in the canning factory make gardens where they cultivate successfully many of the more hardy vegetables.

The principal plant formations discussed were those of the low-lying bogs, the comparatively level grass lands, the higher lying peat bogs, and the alpine flora occupying the rocky hills. Marine plants are not particularly conspicuous, though many brown and red seaweeds occur. Two species of *Potamogeton* are found in the river at the point where the salt and fresh waters meet. Above this point it is comparatively free from vegetation. The country is well watered by small streams. These are often full of various green algæ and they are frequently dammed by dense growths of mosses. Some of the smaller slower brooks are completely blocked by dense growths of species of *Vaucheria*, which so retard the flow of the water as to form low wet bogs that are covered with a characteristic vegetation. The earliest plant to flower in the spring in these vaucheria bogs is the small *Claytonia asarifolia*. Other conspicuous spring plants are a species of *Rumex*, *Caltha palustris* and various species of the Cruciferæ. These bogs are showiest in midsummer when filled with *Polemonium acutifolium*, several species of *Epilobium* and a handsome *Mimulus*. *Epilobium luteum* in particular forms showy masses in the bogs and along the brooks. A large-flowered skunk cabbage also occurs in wet places, frequently marking the course of little brooks along the hillsides. *Carex cryptocarpa* forms a dense zone bordering portions of the river bank.

The drier and comparatively level grass lands are always completely covered by layers of mosses and lichens, so that they approach the condition of the tundras. The first spring flowers of the grass lands are the abundant pink blossoms of the little *Rubus stellatus*, which is also a conspicuous plant in the fall from the rich coloring of its leaves. The turf consists mostly of *Carex Gmelinii*. Scattered plants of species of *Poa* and *Festuca* are frequent, but the dominant grass is a species of *Calamagrostis*. A fragrant grass, a species of *Hierochloa* called locally 'vanilla grass,' occurs, but it is not abundant. Other conspicuous plants are *Trientalis Europea artica*, two species of violets, *Geranium erianthum*, also conspicuous in the fall from its red foliage, a yellow *Castilleia*, *Viburnum pauciflorum*, *Sanguisorba latifolia*, *Galium boreale* and a large showy *Lupinus*. The salmonberry, *Rubus spectabilis*, is frequent and bears a large, delicious, edible berry. In midsummer great patches of fireweed, *Chamænerion angustifolium*, suddenly burst into bloom, giving a most striking color effect. Later in the season *Solidago lepida* becomes conspicuous. *Lathyrus palustris* was the only plant observed having a vine-like habit.

The peat bogs occur at the foot of the hills. Among their characteristic plants are *Betula glandulosa*, a shrub reaching two feet in height; *Empetrum nigrum*, with black fruits that are called 'blackberries' and are eaten by the natives, and *Ledum palustre*, the leaves of which are used for a tea. *Vaccinium ovalifolium* grows along the upper edge of the grass lands. It furnishes an important economic fruit.

The alpine flora on the rocky hills consists of a mat-like growth of mosses, *Cladonias*, *Empetrum*, dwarf blueberries, etc. The first to bloom in the spring is *Mœrania alpina*. The fall foliage of this plant is very showy, forming intense red patches on the hillsides. Other

conspicuous plants are *Aragalus arctica, A. nigrescens, Chamæcestus procumbens, Drapensia Lapponica, Lloydia serotina, Campanula lasiocarpa, Arnica lassingi* and various dwarf arctic willows. *Vaccinium uliginosum* and *V. Vitis-Idæa* are abundant and their fruits are of great economic importance to the natives.

The paper brought out an interesting discussion lasting till the hour for adjournment.

F. S. EARLE,
*Secretary.*

RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

THE regular October meeting was held on the evening of the twenty-first. Dr. Raymond Pearl discussed the problem of the 'Relative Variability of Man and Woman,' and presented statistical evidence of two sorts, bearing on the subject. (1) It was shown that with respect to age at death from *fatal* congenital malformations woman was significantly more variable than man. The standard deviation in age at death for men was 2.104 years, while for women it was 2.699 years, giving a difference of .595 year with a probable error of ± .044. The mean age at death was not significantly different in the two sexes. Since there is a positive correlation between (*a*) the degree or intensity of malformations sufficiently great to cause death, and (*b*) the age at which death occurs, it was maintained that these results give evidence as to the relative variability of the sexes with reference to the degree or intensity of fatal malformations, and indicate a slightly, but significantly, greater variation in the female.

(2) It was shown from an analysis of Marchand's data on human brain-weights that with reference to this character the female was slightly more variable than the male.

These results are in accordance with Pearson's main conclusion from a study of the relative variability of the sexes with respect to a large number of physical characters.

Professor E. D. Campbell read a paper on 'The Diffusion of Sulphides through Steel.' Ten years ago the author had determined the diffusion of sulphide of iron through steel, and later he found that to effect diffusion the sulphide must be an oxysulphide.

That steel should be permeable to liquids even when heated to 1,200° C. was considered so unlikely that Professor J. O. Arnold, of the University Technical College of Sheffield, England, repeated a portion of the work, and confirmed the results.

In September, 1902, H. Le Chatelier, of L'Ecole des Mines, Paris, with M. Ziegler published a paper in which they denied the permeability of iron, stating that the escape of the sulphide of iron was entirely by capillary action through the space between the steel plug and the sides of the hole containing the sulphide. Professor Campbell described a series of experiments in which the sulphide was contained in a long steel tube closed at one end with a tapered screw plug, and heated in such a way that it was impossible for sulphide to escape around the plug. When the steel tubes were heated above 1,200° C. a portion of the sulphide was found to have penetrated the solid walls of the steel tube, thus confirming the author's first contention, that steel when heated to about 1,200° C. is permeable to oxysulphide of iron without increase in the per cent. of sulphur in the steel.

The November meeting occurred on the eighteenth. Mr. G. O. Higley described 'A Method for Determining the Excretion of Carbon Dioxide from the Lungs.' The existing methods for measuring the amount of carbon dioxide in the expired air do not permit a study of the character of sudden changes such as occur at the beginning and at the end of vigorous muscular work, nor such changes as accompany the 'secondary rise' in the pulse rate as described by Bowen (memorial volume of contributions to medical research dedicated to Victor C. Vaughan, 1903). In Mr. Higley's method the expired air, after removal of moisture, is freed from carbon dioxide in an apparatus charged with soda lime, and suspended upon the arm of a balance. A long, light lever attached to the end of the beam greatly magnifies the movements of the beam, and writes the curve of carbon dioxide excretion upon the blackened paper of a kymograph drum. On the same drum may

be recorded the carotid pulse, the respiration, the time in seconds and the rate of muscular movements. Experiments made with this apparatus show that the curve of carbon dioxide excretion during work closely resembles that of the pulse, and that carbon dioxide is at least in part the cause of the secondary rise in the pulse rate observed by Bowen.

Dr. W. B. Pillsbury detailed some experiments on 'The Attention Wave as a Measure of Fatigue.' Not merely the daily rhythm of fatigue and practise of the typical morning and evening workers was reflected in the ratios of the period of visibility to the period of invisibility in the attention wave, but the degree of fatigue on days of severe work as compared with easy days had a corresponding variation in the fluctuation of attention. In the morning, practise shows itself in a continuous increase in efficiency through at least a considerable portion of the experiment; while in the evening there is a decreasing effectiveness almost from the beginning. As further substantiation of the theory that the attention wave is closely related to the Traube-Hering or Mayer vaso-motor waves, it was noted that both have the same daily rhythm of length.

Frederick C. Newcombe,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### MORGAN ON EVOLUTION AND ADAPTATION.

To the Editor of Science: I have always supposed that what are generally called Lamarckian views of evolution were considered with less prejudice by biologists in the United States than in England or Europe, and that my own publications in support of such views were, therefore, likely to be known and read in America even if they were almost completely ignored by my own countrymen.

I find, however, that Dr. Thomas Hunt Morgan in his book 'Evolution and Adaptation,' which has just appeared, makes no mention whatever of my book 'Sexual Dimorphism in the Animal Kingdom, a Theory of the Origin of Secondary Sexual Characters,' which was published in London more than three years ago. Any biologist, American or other, has a perfect right to reject all my conclusions, but it seems to me that an author who devotes a great part of his book to the discussion of Darwin's theory of sexual selection and the evolution of secondary sexual characters, in entire ignorance of the facts and arguments which it cost me years of labor to collect and elaborate, lays himself open to the charge of writing without proper knowledge of the literature of his subject. I have published the results of experimental work apart from this, but the only reference Dr. Morgan makes to it is to a popular article in *Natural Science;* he has not apparently consulted the original memoirs.

Like other English writers it has been my ambition that my work should be known to the scientific public of the United States, which is not only very intelligent but free from prejudices which are stronger than reason in England. I am much disappointed to find that my chief contribution to the investigation of evolution is so little known to American evolutionists.

J. T. Cunningham.
Zoological Society,
3 Hanover Square, London, W.

### MUTATION AND SELECTION.

In reading Professor Morgan's very interesting and valuable book, 'Evolution and Adaptation,' it is surprising to find that he apparently regards the theory of evolution by selection and DeVries's mutation theory as being to a degree in conflict.

The evolution which observation shows us has taken place is chiefly characterized by the fact that it has brought organisms into favorable relation with their environmental conditions. That this could have been secured by mutation unaided by selection seems altogether unlikely.

In the case of the leaf butterflies of the genus *Kallima* the theory of evolution by mutation alone must assume that the remarkable resemblance arose all at once by a single mutation, or that there were a series of mutations which for some unaccountable reason were of such a character as to make the resemblance to a leaf gradually grow more perfect, though no selective action of the environment controlled this improvement in pattern.

The first assumption, of the origin of the perfect leaf pattern by a single mutation, is unsupported by evidence and to me seems very improbable. That the resemblance arose by the cumulation of a series of mutations independent of selection seems no less improbable, for in this case we have either to assume some mysterious internal regulation of the mutations directing them all in one direction, or else we must assume that among the many possible mutations only those that were in the direction of closer imitation happened to occur. The latter is of course practically impossible upon the theory of probabilities and the former leads us into a realm of darkness which we seem at present unable to explore. If, however, there is reason to believe in such internal directive influence, we are not justified in rejecting it because of our inability to study its nature and action. I can not see that we have such evidence.

I have been impressed with the feeling that Professor Morgan has allowed his opposition to Darwin's conception of evolution by the selection of favorable 'fluctuating variations' to cause him to understate the importance of selection, though in parts of his book he recognizes that selection acts on mutants and variants. The Darwinian theory and the theory of evolution by selection are not identical, yet Professor Morgan frequently refers to them as if they were so. If mutations be distinct from fluctuating variations, as our as yet very scanty evidence seems to suggest may be the case, still both mutations and variations, so far as we can see, would be subject to selection. The theory of selection is an explanation of some of the phenomena of adaptation. It is difficult to see that the mutation theory, apart from selection, aids us in understanding or imagining how this adaptation, the most general phenomenon in organisms, has been secured.

Mutation may be the mode of origin of certain useful qualities, but it is difficult to see how it explains their retention and perfection. The theory of selection makes no pretense to explain the origin of varieties or mutations. It attempts to explain the adaptation of organisms to their conditions of life, such adaptation resulting from the selection of those individuals which vary or mutate in useful directions. The theory of selection begins where the theory of mutation leaves off.

Not even a combination of DeVries's mutation theory with Weismann's theory of germinal selection would give us, without natural selection, an explanation of progressive perfection of adaptation. We should still need to add Nägeli's, or rather St. George Mivart's, perfecting principle.

The work of DeVries seems especially valuable since it brings to the front such questions as the following:

Are there mutations which are distinct from fluctuating variations? Are fluctuating variations restricted to rather narrow limits, and are the larger variations which occur of a different sort, establishing a new mean about which a new series of fluctuating variations cluster?

Are mutations (or variations) definite or indefinite? Do they follow certain lines or do they occur in all directions?

If the direction of mutations (or variations) is wholly or in part predetermined, what are these predetermining factors? Are they internal (involved in the nature of the organism), or external (environmental), or both?

Is there a tendency in mutants (or variants) to revert toward the condition of the parent stock?

Are mutants (or variants) of one sort more (or less) fertile or more (or less) vigorous when bred together than when bred with the parent stock or with mutants (or variants) of another sort? Does mutation (or variation) cause partial (or complete) segregation?

Are hybrids between mutants (or variants) of different sorts or between mutants (or variants) and the parent stock intermediate in character between the two parents, or do they follow wholly or chiefly one parent? If the latter, which parent is followed in the several kinds of crosses?

Upon most of these points the observations of DeVries have an important bearing, though, without much further observation, they do not decide them.

It seems possible that one of the most im-

portant results of the work carried on by and stimulated by DeVries will be to show another way in which partial segregation may be secured, and the theory of natural selection needs all the help it can get from segregation.

It should hardly be necessary to urge that, in understanding the development of the conditions which prevail to-day among organisms, the problem of the origin of species seems of very secondary importance in comparison with the problem of the perfection of adaptation.

Maynard M. Metcalf.
The Woman's College of Baltimore.

### WILBUR WRIGHT'S SUCCESSFUL FLIGHT IN A MOTOR-DRIVEN AEROPLANE.

The newspapers of December 18 contained the announcement that Wilbur Wright had flown a distance of three miles with an aeroplane propelled by a 16-horse power, four-cylinder, gasoline motor, the whole weighing more than 700 pounds. To the average newspaper reader this meant no more than similar statements previously made in the newspapers that men had flown in New York, or St. Louis, or San Francisco. But to the student of aeronautics, and particularly to those who had followed the careful scientific experiments with aeroplanes which were being made by Orville and Wilbur Wright, it meant an epoch in the progress of invention and achievement, perhaps as great as that when Stevenson first drove a locomotive along a railroad.

It meant that after ages of endeavor man had at last been able to support himself in the air as does a bird and to land in safety at a spot chosen in advance.

The report from an authoritative source confirms the fact of this flight, but modifies the details somewhat from those given in the newspapers. It appears that four successful flights were made in a motor-driven aeroplane on December 17 near Kitty Hawk, N. C. The wind was blowing about 21 miles an hour and a speed relative to the wind of 31 miles an hour was attained by the aeroplane. This meant a speed of 10 miles an hour relative to the ground. The aeroplane had a surface of 510 square feet and in the longest flight was in the air 57 seconds. The aeroplane is said to have risen from a level. The reported distance of three miles was probably relative to the wind.

The earlier work of the Wright brothers is described in the reports of the Western Society of Engineers and in part republished in the Annual Report of the Smithsonian Institution for 1902. Their invention of a forward rudder has contributed to the final success.

The modern success in aeronautics may be said, I think, to date from the feat of Otto Lilienthal in 1891 in gliding down an incline in an aeroplane. These glides were repeated with much success and with an improvised aeroplane by Mr. Chanute and Mr. Herring in our own country. Mr. Herring even went so far as to carry with him 50 pounds of sand in his aeroplane which weight he computed would be that of an engine sufficient to support him.

Mr. Pilcher, in England, repeated these experiments on a level by rising into the air in his machine when drawn by a horse attached to a rope, the machine rising like a kite and then gliding forward. Mr. Whitehead is described in the *Scientific American* as having repeated this experiment recently in Connecticut with a motor on board the aeroplane.

In the meantime, in 1896, Dr. Langley had driven a model weighing about 25 pounds through the air with a small steam-engine, and Sir Hiram Maxim had performed the wonderful feat of lifting 7,000 pounds into the air for a moment. This was done with an aeroplane having 5,000 square feet of surface driven by serial screws attached to a steam-engine of 360 horse-power and of extraordinary lightness.

But, notwithstanding all these partial successes, there was, owing to the recently reported failure of Dr. Langley to lift a man and to other causes, a wide skepticism as to the possibility of human flight.

Mr. Wright's success in rising and landing safely with a motor-driven aeroplane is a crowning achievement showing the possibility of human flight. Much yet remains to be done, but with the stimulus of this beginning progress will probably be rapid. In the progress now achieved a great deal is due to Mr.

Octave Chanute, an eminent American engineer, whose enthusiasm and great knowledge have stimulated the work of Herring, Hufaker, the Wrights and many others, and whose advice and supervision was freely given in perfecting the machine which has finally succeeded.

H. H. CLAYTON.

### THE EDITORIAL COMMITTEE OF SCIENCE.

AT the recent meeting of the American Association for the Advancement of Science, the council resolved to add the vice-presidents of the association and the permanent secretary to the editorial committee of SCIENCE. The vice-presidents of the association, each of whom is chairman of one of the ten sections, represent the sciences covered by the journal, and are always among the most efficient and active men of science of the country. Their cooperation during their term of office will greatly promote the interests of the association and of the journal. We also hope to secure the cooperation of several other men of science in order that all branches of science and all parts of the country may be adequately represented. The members of the committee who have had control of the journal during the nine years of the new series will of course remain as heretofore. SCIENCE is now so well established as the representative organ of American men of science that it seems unnecessary to print each week the names of the editorial committee and of the responsible editor.

### SCIENTIFIC NOTES AND NEWS.

WE hope to publish next week the official report of the St. Louis meeting of the American Association for the Advancement of Science, and as soon as possible the reports of the societies meeting in affiliation with it and of the other societies that met during convocation week at Philadelphia and elsewhere. Professor Farlow, of Harvard University, the eminent botanist, was elected president of the association, and vice-presidents were elected as follows: Professor Alexander Ziwet, of the University of Michigan, Section of Mathematics and Astronomy; Professor W. F. Magie, Princeton University, Section of Physics; Professor C. P. Kinnicutt, Worcester Polytechnic Institute, Section of Chemistry; Professor D. S. Jacobus, Stevens Institute of Technology, Section of Mechanical Science and Engineering; Professor E. A. Smith, University of Alabama, Section of Geology and Geography; Dr. C. Hart Merriam, U. S. Biological Survey, Section of Zoology; Professor B. L. Robinson, Harvard University, Section of Botany; Dr. Walter Hough, U. S. National Museum, Section of Anthropology; Martin A. Knapp, Interstate Commission of Commerce, Section of Social and Economic Science. President C. S. Howe, Case School of Applied Science, was elected secretary of the council, and Professor C. A. Waldo, Purdue University, general secretary. The association will meet next year at Philadelphia and the following year at New Orleans.

THE American Society of Naturalists at the annual meeting in St. Louis last week elected officers as follows: *President,* E. L. Mark, Harvard University; *vice-president for the Eastern Section,* Franklin P. Mall, the Johns Hopkins University; *vice-president for the Central Section,* John M. Coulter, of the University of Chicago; *secretary,* Chas. B. Davenport, University of Chicago; *treasurer,* Hermann von Schrenk, Missouri Botanical Garden and the Bureau of Forestry; *additional members of the executive committee,* Professor J. McKeen Cattell, Columbia University, and Professor William Trelease, Missouri Botanical Garden. The program of the Naturalists at St. Louis was similar to that of recent years. On Tuesday evening President David Starr Jordan, Stanford University, gave an illustrated lecture on 'The Resources of the Sea,' which was followed by a smoker at the University Club. On Wednesday afternoon the annual discussion was held, the subject being 'What kind of degrees should be conferred for scientific work?' the opening speakers being President Jordan, President Van Hise, Professor Cattell and Professor Coulter. The annual dinner was held on Tuesday evening at the Mercantile Club, and was followed by the address of the presi-

dent, Director William Trelease, of the Missouri Botanical Garden, whose subject was 'Critical Periods in the Life of a Naturalist.' We hope to publish subsequently this address and the discussion.

At the annual meeting of the Geological Society of America at St. Louis, Professor H. L. Fairchild, University of Rochester, was elected president; Professor J. C. Branner, Stanford University, secretary, and Professor I. C. White, University of West Virginia, treasurer.

At the twelfth annual meeting of the American Psychological Association held at St. Louis last week, Professor William James was elected president. This is the only occasion on which a past president has been reelected president of the association. Professor Livingston Farrand, Columbia University, will continue as secretary, and the members of the executive committee elected to succeed the retiring members, Professor John Dewey, of the University of Chicago, and Professor J. Mark Baldwin, of the Johns Hopkins University, were Professor Hugo Münsterberg, of Harvard University, and Dr. Henry Rutgers Marshall, of New York City.

At the third annual meeting of the American Philosophical Association, held at Princeton on December 29, 30 and 31, Professor G. T. Ladd, of Yale University, was elected president; Professor Frank Thilly, of the University of Missouri, vice-president, and Professor H. N. Gardiner, of Smith College, secretary-treasurer. The new members of the executive committee are Professor James H. Tufts, University of Chicago, and Professor H. Heath Bawden, Vassar College.

Officers of the New York Academy of Sciences have been elected as follows: *President,* Edmund B. Wilson. *Vice-presidents:* Section of Geology and Mineralogy, James F. Kemp; Section of Biology, L. M. Underwood; Section of Astronomy, Physics and Chemistry, Chas. Lane Poor; Section of Anthropology and Psychology, F. J. E. Woodbridge. *Corresponding secretary,* Richard E. Dodge. *Recording secretary,* Henry E. Crampton. *Treasurer,* Charles F. Cox. *Librarian,* Ralph W. Tower. *Editor,* Chas. Lane Poor. *Councilors* (to serve three years), Livingston Farrand, E. O. Hovey. *Finance committee,* John H. Hinton, C. A. Post, Henry F. Osborn.

It is announced that Mr. John Morley will deliver the principal address at the opening of the Technical Institution, founded at Pittsburg by Mr. Carnegie, in the autumn of 1904.

Oxford University has conferred the degree of D.C.L. on Mr. Henry Wilde, F.R.S., inventor of the dynamo electric machine. Mr. Wilde is the founder of the Wilde Readership in Mental Philosophy and of the John Locke scholarship on the same subject.

The large gold medal for services rendered to art and science has been awarded by the German government to Professor Paul Ehrlich, director of the Imperial Institute of Experimental Therapeutics at Frankfort.

Mr. Reginald Innes Pocock, F.Z.S., assistant at the Natural History Museum, South Kensington, has been appointed resident superintendent of the Gardens of the London Zoological Society. Mr. Pocock entered on his duties on January 1, 1904.

The United States Archeological and Ethnological Commission met at the State Department on December 21. Dr. W J McGee, the anthropologist of the Louisiana Purchase Exposition, is chairman of the commission. The other members are Mr. Volney W. Fost, of Chicago, and Professor Francis B. Kelsey, professor of Latin language and literature, the University of Michigan.

Mr. Gurdon Trumbull, the well-known artist and ornithologist, died in Hartford, Conn., on December 28, in the sixty-third year of his age.

A fire, on December 27, in the building in Washington occupied by the U. S. Geological Survey caused a loss estimated at $15,000, including the destruction of some valuable maps and records.

The *Matin* announces that it has placed the sum of 30,000*f*. at the disposal of Professor d'Arsonval in order to enable him to continue his researches in connection with the properties of radium.

THE U. S. Geological Survey will make an exhibit at the Lousiana Purchase Exposition in St. Louis which will illustrate the survey's methods of work and the products of its various branches as completely as the space placed at its disposal will permit. Small pamphlets containing descriptions of the methods of work pursued by the different branches, divisions, and sections of the survey will be published for distribution during the exposition.

SECRETARY CORTELYOU has recommended the establishment at Washington under the Bureau of Fisheries of an aquarium that shall surpass in importance any similar institution.

REUTER'S AGENCY is informed that a scientific expedition, which has been organized by the anthropological section of the St. Louis Exhibition, is about to leave England for Central Africa under the direction of Mr. S. P. Verner, who landed a few days ago from New York. Since his arrival in England Mr. Verner has been to Brussels to consult with the authorities there regarding his expedition. With reference to his journey Mr. Verner says: "In order to get at the aboriginal life as little changed as possible by the inroads of civilization it is desired to go entirely out of the track of previous explorers, as well as of all settlers, and to enter the most untouched region to which access can be obtained. One of these regions is that between the Congo and Zambesi valleys, to the north of Livingstone's and the south of Stanley's journeys. This territory embraces, among others, the vast Lunda Plateau. It is into this and contiguous territories that the expedition is proceeding. The region is 1,500 miles from the West Coast. The fact that the enterprise leads into a country of cannibals and savages, and that the attainment of our object requires diplomacy and tact in dealing with the natives, makes the mission one of difficulty and hazard. The time at its disposal also will make it, if successful, a notable exploit. To secure permission and cooperation of the European governments controlling the territories in question representations are being made by the government of the United States. Our base of operations will be from the capital of Chief Ndombe, paramount chieftain of the Lunda tribes, at the head of navigation of the Kassai river, the largest southern tributary of the Congo, from which place an effort will be made to penetrate the interior. Ndombe is one of the most remarkable of living African rulers. He is peculiar for being of a bright copper color, as are his family, although there has been no known white blood in his ancestry. He is also a firm friend of the white man, having signified his assent to white suzerainty over his domain, and having instructed his people to recognize the authority of the foreigners. His general jurisdiction is very extensive, and, including federated and associated tribes, may be said to include several million people over a territory of several hundred thousand square miles. His own immediate family and their blood relations are known as the Bakwampesh, a word almost exactly equivalent to 'aristocracy.' In his territory are tribes of pygmies, of cannibals, and the last remnant of the once powerful transcontinental slave-traders, the Bimbadi. The scientific interest attaching to this expedition arises from the fact that it has lately become strongly suspected that the most primitive forms of the human race are to be found in remote Africa, the oldest region known where the native life has been longest undisturbed by outside influences. It is desirable to record the conditions now existent there and to obtain specimens of the arts and products of the people before they have changed their aboriginal ways for the innovations of rapidly approaching civilization."

MR. ERNEST ALYSCOGHE FLOYER, inspector-general of Egyptian telegraphs, died at Cairo on December 1 from heart disease, at the age of fifty-one years. We learn from the London *Times* that Mr. Floyer was educated at the Charterhouse, receiving in 1869 an appointment in the Indian Telegraph Service. In 1876 he received his first long leave, and started, unaided and alone, for the unexplored interior of Baluchistan. His observations and surveys on this difficult and dangerous journey were of considerable geographical interest. He returned to London in the same year, and sub-

sequently published an account of his travels in a work entitled 'Unexplored Baluchistan.' In the same year (1876) he was appointed inspector-general of Egyptian telegraphs. In 1887 he surveyed, and described in the 'Proceedings of the Royal Geographical Society,' 'Two Routes in the Eastern Desert of Egypt,' and later described the results of an expedition to the same desert in an official publication entitled 'Etude sur la Nord-Etbai.' It was during this journey that he rediscovered the ancient emerald mines of the Egyptians, and his maps and observations have been the basis for the subsequent exploitation of minerals in this region. During the last decade Mr. Floyer devoted much attention to the reclamation, by judicious planting, of the land which had been lost to cultivation by the encroachment of drifting sand upon the western border of the Delta.

It is proposed to establish under the auspices of the International Sanitary Conference an international sanitary bureau for the collection of information respecting infectious diseases, such as plague, cholera and yellow fever, and also for the harmonious working of those sanitary regulations in the east which have so greatly contributed within the last five years to the preservation of public health, as well as to the benefit of trade, by the suppression of the old quarantine system. If the movement is successful the bureau will have its headquarters in Paris.

## UNIVERSITY AND EDUCATIONAL NEWS.

The will of the late Washington Corrington, of Peoria, Ill., leaves the entire estate, valued at $750,000, for the founding of an educational institution to be known as Corrington Institute and University. The estate is to be managed by trustees until it reaches $1,500,000, when work is to be begun at Mr. Corrington's late home, just outside the limits of Peoria. Professor John M. Coulter, of the University of Chicago, is one of the trustees.

By the will of the late Ruth A. Hoar, the Worcester Polytechnic Institute receives $5,000 and Clark University will ultimately receive $30,000.

Palmer University, at Muncie, Ind., has secured the $100,000 necessary to obtain the endowment of $100,000 left by the late F. A. Palmer.

Dr. Edward Hitchcock, Jr., for several years professor of physical culture and hygiene and director of the gymnasium at Cornell University, has resigned.

Professor W. A. S. Hewins, M.A., having resigned the post of director of the London School of Economics and Political Science, the senate has appointed in his place Mr. H. J. Mackinder, M.A., lecturer in economic geography at that institution. Mr. Mackinder has lately resigned the principalship of University College, Reading, but will continue his lectures on economic geography in the University of London and historical geography in the University of Oxford.

Mr. William Ravenscroft Hughes, B.A., has been elected to a fellowship in Jesus College, Cambridge University. Mr. Hughes was fifth wrangler in the mathematical tripos, 1902.

The council of King's College, London, has appointed to the chair of mathematics Mr. S. A. F. White, M.A., of Wadham College, Oxford, who has been demonstrator in natural philosophy in King's College since 1895. The council has also appointed Mr. E. F. Herroun assistant professor of physics, and Mr. J. B. Dale, M.A., of St. John's College, Cambridge, assistant professor of mathematics.

Sir John Scott Burdon-Sanderson, M.A., D.M., hon. fellow of Magdalen, and Regius professor of medicine at Oxford University, has placed his resignation of the professorship in the hands of the vice-chancellor. Sir John Burdon-Sanderson was appointed to the regius professorship, to which is annexed the Aldrichian professorship of the practise of medicine, in 1895, upon the resignation of the late Sir Henry Acland, who had occupied the chair for thirty-eight years. Professor Burdon-Sanderson was the first occupant of the Waynflete chair of physiology, to which he was appointed in 1883, his successor being the present professor, Dr. Gotch.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 15, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

### *PROCEEDINGS OF THE ST. LOUIS MEETING.*

THE fifty-third annual meeting of the American Association for the Advancement of Science was held in St. Louis, December 26, 1903, to January 1, 1904. This was the second time the association had met in St. Louis, the first being the twenty-seventh meeting in 1878. The association has met west of the Mississippi but six times.

The number of members in attendance was 385, while the number in the affiliated societies was 81, making a total attendance of 466. This places the meeting fifth in point of numbers of those held during the last ten years. As the total membership has rapidly increased in this time, this would seem to be a small meeting, but there are various reasons to account for it. The first and strongest of them is that the exposition will be held in St. Louis next summer and a large number of the members expect to visit the city at that time. Hence they did not feel like going to St. Louis in the winter, notwithstanding their strong desire to attend the meeting of the association.

Although the meeting was small in point of numbers, it was large in point of papers and earnest work in the section room. Many of the sections were very largely attended and had so many papers that they could not complete them during the regular time assigned. Several evening meetings were held, and at least two of the sections held meetings after the final adjournment of the association. This shows that the

meeting was what might be called a working meeting. Those who had papers to present were there and took active part in the proceedings. It was unfortunate that a larger number could not have been present, but any meeting at which a large number of papers is presented, and where a strong and vital interest is taken in the work of the section room must be called a successful one.

Perhaps the second reason why the attendance was small was in the fact that the policy of the association, which calls for working meetings, does not meet hearty support from all of the members. There is still some discussion going on as to whether it would be better to have a summer meeting or a winter meeting, or perhaps both. Some of the older members do not feel like traveling long distances during the winter and subjecting themselves to the changes of temperature and other discomforts which come from winter travel. In some cases it is not possible for college professors to get away from their institutions during the week of the meeting, and still others do not like to leave their families during the holiday vacation. On the other hand, the majority of those present seemed to feel that it was best to continue the present method, for a time at least. There was no open opposition to the winter sessions, and when the vote was taken in the general committee the winter meeting for next year was unanimously decided upon.

Winter meetings do not readily lend themselves to excursions. The time must be taken up in the reading and discussion of papers, and the social element must come in the form of banquets and smokers. St. Louis did all in its power to entertain the convention, and several excursions were arranged, notwithstanding the unfavorable season.

AFFILIATED SOCIETIES.

The following affiliated societies held meetings in conjunction with the association:

The American Anthropological Association.
The American Chemical Society.
The American Mathematical Society (Chicago Section).
The American Microscopical Society.
The American Physical Society.
The American Psychological Association.
The American Society of Naturalists.
The American Society of Zoologists (Central Branch).
The Association of Economic Entomologists.
The Association of Plant and Animal Breeders.
The Astronomical and Astrophysical Society of America.
The Botanical Club of the Association.
The Botanical Society of America.
The Central Botanists' Association.
The Entomological Club of the Association.
The Fern Chapter.
The Geological Society of America.
The Sigma Xi Honorary Scientific Society.
The Society for Horticultural Science.
The Society for the Promotion of Agricultural Science.
The Wild Flower Preservation Society of America.

The policy of encouraging the affiliation of scientific societies with this association has been continued, and two more societies, the Society of College Teachers of Education and the Society for Horticultural Science, have been added to the list. Some of the strongest of the affiliated societies have not sought any connection with this association. It would seem that an earnest effort should be made to bring about some connection between these organizations and our own. 'In union there is strength.' The scientific forces of the country should stand together, and whenever it comes that assistance is needed for scientific research, or favorable legislation is needed for any purpose, it will be obtained much more readily if it is known that practically all the scientists of the country are back of the association which asks for such action.

The first session of the meeting was called

to order in the auditorium of the Central High School, at 10 A.M., Monday, December 28, 1903, by the retiring president, Dr. Ira Remsen.

Dr. Remsen introduced the president-elect, Dr. Carroll D. Wright. Addresses of welcome were then made by the Hon. D. R. Francis on behalf of the local committee, by the Hon. C. P. Walbridge on behalf of the city of St. Louis, and by Professor C. M. Woodward on behalf of the educational institutions of the city and the state. To these addresses President Wright replied for the association.

President Wright announced that each day the council would meet at nine o'clock and the general session at ten o'clock.

After the adjournment of the general session the several sections were organized in their respective rooms.

On Monday afternoon the vice-presidents' addresses were given as follows:

At 2:30 P.M.

Vice-President Halsted before the Section of Mathematics and Astronomy, in Room B2, entitled 'The Message of Non-Euclidean Geometry.'

Vice-President Baskerville before the Section of Chemistry, in Room 102, entitled 'The Elements: Verified and Unverified.'

Vice-President Davis before the Section of Geology, in Room 202, entitled 'Geography in the United States.'

At 4:00 P.M.

Vice-President Waldo before the Section of Mechanical Science and Engineering, in Room 310.

Vice-President Hargitt before the Section of Zoology, in Room 202, entitled 'Some Unsolved Problems of Organic Adaptation.'

Vice-President Coville before the Section of Botany, in Room 102.

Vice-President Newcomb before the Section of Social and Economic Science, in the auditorium, entitled 'Some Recent Phases of the Labor Problem.'

The address of Vice-President Nichols before the Section of Physics was omitted, owing to the absence of Mr. Nichols, who was detained by sickness in his family.

On Monday evening the address of the retiring president, Dr. Ira Remsen, entitled 'Scientific Investigation and Progress,' was given at the Odeon.

On Tuesday evening, President David Starr Jordan, of Leland Stanford Junior University, gave a public lecture on 'The Resources of Our Seas.' After the lecture the American Society of Naturalists and affiliated societies held their annual smoker at the University Club.

On Wednesday morning Dr. George A. Dorsey delivered his address as retiring president of Section H, upon the subject 'The Future of the American Indian.'

On Wednesday afternoon the American Society of Naturalists held their annual public discussion, the subject being 'What Academic Degrees should be conferred for Scientific Work?'

On Wednesday afternoon Professor E. Rutherford, of McGill University, Montreal, Canada, gave an illustrated public lecture on the subject 'Radium and Radioactivity.'

On Wednesday evening the retiring president of the American Chemical Society, Dr. John H. Long, delivered an address upon the subject 'Some Problems in Fermentation.'

On Wednesday evening the American Society of Naturalists held its annual dinner at the Mercantile Club, after which was given the address of the retiring president, Professor William Trelease.

On Wednesday evening the annual dinner of the American Chemical Society and Section C was given at Faust's.

On Wednesday evening Dr. S. F. Emmons gave the president's address before the Geological Society of America at the Planters' Hotel.

On Thursday afternoon, by invitation of the officers of the Louisiana Purchase Exposition, the members of the association and affiliated societies visited the exposition grounds. A buffet luncheon was tendered the association by the officers of the exposi-

tion, after which they were taken in small parties through the grounds and buildings and shown the various exhibits, under the personal charge of the chiefs of departments.

On Thursday evening the annual banquet of the Sigma Xi Honorary Scientific Society was given at the Mercantile Club, followed by the address of President David Starr Jordan.

On Friday evening the members of the association attended the fourteenth annual banquet given by the trustees of the Missouri Botanical Garden at the Southern Hotel.

REPORTS OF COMMITTEES.

The following reports of committees were presented to the council. They were accepted and ordered printed.

*On the Atomic Weight of Thorium.*

*To the Council of the American Association for the Advancement of Science.*

*Gentlemen:* Since our last report we beg leave to state that Messrs. Charles Baskerville and R. O. E. Davis have secured further evidence of the complexity of the so-called element, thorium. This work has resulted from applications of methods of fractionation to the large amounts of purified material with which they were engaged, as stated in our last report. Under such circumstances these gentlemen deemed it advisable to prosecute further the fractionation until a stable thorium preparation was secured. This fractionation is controlled by atomic weight determinations and spectroscopic examinations.

At the Washington meeting of the council, a grant of fifty dollars was made Mr. Charles Baskerville for work on præseodidymium and the supervision of the same given over to this committee. Concerning this, we beg leave to state that Messrs. Baskerville, James Thorpe and T. B. Foust have secured about one kilogram of quite pure oxide by novel methods. At present Messrs. Baskerville and G. MacNider are subjecting a considerable portion of this purified material to a treatment which promises to show the complexity of this so-called element.

We therefore, beg leave to report progress.

Respectfully,

CHAS. BASKERVILLE, *Chairman*,
FRANCIS P. VENABLE,
JAS. LEWIS HOWE.

*On the Relation of Plants to Climate.*

*Gentlemen:* The committee on the relation of plants to climate presents herewith a paper entitled 'Soil Temperatures and Vegetation,' which sets forth recent results obtained by the aid of grants received in 1901 and 1902, and which was published in Contributions from the New York Botanical Garden (No. 44).

Your committee is desirous of extending the observations already made to cover a wider range of soil and climatic conditions, and has secured the cooperation of the New York Botanical Garden and of the Desert Botanical Laboratory of the Carnegie Institution, both of which have undertaken the purchase and installation of sets of instruments. The major inquiry is concerned with the influence of the temperature of soils, with its diurnal and seasonal variations, upon growth and distribution of plants. As a result of the observations already made it has been found that different portions of the body of even small plants may differ as much as 40° F. in temperature, a fact which has hitherto escaped notice and which promises to be of great importance in the interpretation of the physical processes of the plants. In order to carry along the entailed investigations, your committee asks an additional grant of seventy-five dollars.

During the course of the work, the Hallock soil thermograph has been invented and perfected. Specifications have been placed in the hands of a competent instrument maker, and no limitations of any kind placed on its manufacture or use. The numbers of applications for instruments show that it is deemed useful for thermometric work in various kinds of observations.

Respectfully,

D. T. MACDOUGAL,
*For the Committee.*
WILLIAM TRELEASE,
J. M. COULTER,
D. T. MACDOUGAL,
*Committee.*

*On Anthropometric Tests.*

The committee of the association on anthropometric tests has continued its work throughout the year. A laboratory for physical and mental measurements was arranged at Washington, and tests of the fellows and members of the association were made by Mr. Miner and Mr. Davis under the direction of the chairman of the committee. The results of measurements of about one hundred fellows have been compiled and compared with similar measurements of members of the British Association and of other classes of the

community, but the data are not yet sufficiently numerous for publication. Dr. McGee, of the committee, has taken steps toward the establishment of anthropometric and psychometric laboratories as part of the Louisiana Purchase Exposition, with special reference to the measurement of the savage tribes that will be gathered there. Professor Boas, of the committee, has published measurements of the cephalic index in relation to Mendel's law, and has carried forward anthropometric work in other directions. The chairman of the committee has published two papers on the natural history of American men of science, seeking to apply metric methods to merit and other individual differences. Numerous measurements of physical and mental traits have been made in the psychological laboratory of Columbia University, and work has been carried on in the schools of New York City on the resemblance of brothers and twins, and in other directions. Professor Thorndike has published a book on 'Educational Psychology,' concerned especially with the application of anthropometric methods to children.

It did not appear feasible to arrange an anthropometric laboratory at St. Louis. We ask that the fifty dollars appropriated for such a laboratory be made available for next year.

J. McKEEN CATTELL,
*Chairman.*

*On Indexing Chemical Literature.*

The committee on indexing chemical literature, appointed by your body at the Montreal meeting in 1882, respectfully presents to the Chemical Section its twenty-first annual report, covering the twelve months ending June 1, 1903.

*Works Published.*

'An Index to the Literature of Thorium (1817–1902).' By Cavalier H. Jouet, Ph.D. Smithsonian Miscellaneous Collections, No. 1374. Washington City, 1903.

'References to Capillarity to the End of the Year 1900.' By John Uri Lloyd (aided by Sigmund Waldbott). Bulletin No. 4 of the Lloyd Library of Botany, Pharmacy and Materia Medica. Cincinnati, Ohio, 1902. 8vo. 212 pp.

The 665 'references' extend from 1519 to 1900; each is accompanied by a summary of the contents of the paper cited.

*The Journal of the American Chemical Society.* General Index to the first twenty volumes, 1879–1898, and to the proceedings, 1877–1879. Easton, Pa., 1902. 8vo. 237 pp.

Though issued anonymously, the preface bears the initials of E. W. Morley and O. F. Tower, and the labor was one of love. Accuracy of detail and adequate treatment on every page are its admirable features. Besides an index of authors and an index of subjects, there is an index of obituaries which is suggestive. Also an index of new books.

*Notes on Foreign Bibliographies.*

'A Bibliography of Steel-works Analysis,' by Harry Brearly, forms an appendix to the volume entitled 'The Analysis of Steel-works Materials,' by Harry Brearly and Fred Ibbotson. London, 1902.

This bibliography comprises 1,858 references, which occupy more than 130 pages octavo. The items are grouped under seven heads, besides minor subdivisions; the literature is, however, very incomplete, being confined to four British journals.

'A Catalogue of the Library of the Chemical Society (of London).' Arranged according to authors with a subject index. London, 1903. 8vo. 342 pp.

'International Catalogue of Scientific Literature.' First Annual Issue (for the year 1901). D, Chemistry. Published for the International Council by the Royal Society of London. London, 1902. Vol. II., Part I. June, 1902.

*Work in Progress.*

A second supplement to the 'Select Bibliography of Chemistry,' by Dr. H. Carrington Bolton, has been completed and accepted for publication by the Smithsonian Institution. It brings the literature down to the end of the year 1902.

An index to the literature of cadmium has been begun by Professor Ernest N. Pattee, of Syracuse University.

An index to the literature of glucinum has been begun by Professor Charles L. Parsons, of New Hampshire College, Durham, New Hampshire.

An index to the literature of germanium, gallium and indium has been begun by Dr. Philip E. Browning, of New Haven, Connecticut.

Mr. Frank R. Fraprie, writing from Munich, Bavaria, reports substantial progress on an index to the literature of lithium, cæsium and rubidium.

Mr. Benton Dales is engaged on an index to the literature of the yttrium group of the rare earths. His address is Ithaca, New York.

H. CARRINGTON BOLTON (in Europe),
F. W. CLARKE (in Europe),
ALBERT B. PRESCOTT,
ALFRED TUCKERMAN,
H. W. WILEY,
*Committee.*

June 1, 1903.

*On the Velocity of Light.*

The committee reports progress since the Pittsburg meeting in the preliminary study of the methods of determining the group velocity and the absolute velocity of light in ponderable media and in space.

The practicability of the method, involving the use of electric double refraction and electric oscillations for producing groups of waves, and the examination of them through a column of water at least 100 feet long and probably twice that distance, has been established.

An estimate from the corresponding optical conditions in air would make the available distance several miles. The preliminary study of the method for determining the absolute velocity has not yet been completed, but the apparatus is partly mounted and in place.

The committee petitions a further grant of seventy-five dollars for the continuance of the preliminary experiments now in progress.

Respectfully submitted,
D. B. Brace,
*For the Committee.*

*On the Teaching of Anthropology in America.*

*To the President and Council:* Your committee on the teaching of anthropology in America beg to report progress.

During the year 1902 (for which a brief report was submitted to the council, though apparently lost before reaching the secretary of the council), the committee held one or two conferences, while different members took individual action in accordance with the general policy looking toward the promotion of anthropologic education in several leading institutions. Dr. MacCurdy, of the committee, continued the collection and publication of statistics as to the teaching of anthropology; and Dr. Boas, Dr. Russell and the chairman of the committee delivered addresses and published papers advocating the extension and betterment of anthropologic teaching in this country. During the year 1903 the committee have continued work, chiefly as individuals, and different members have been consulted and have expressed opinions as to the value of anthropology as a subject of instruction in educational institutions. Recently the committee has suffered a grievous loss in the death of Dr. Frank Russell, one of the original members of the committee.

It is recommended that the committee be continued, and that the vacancy created by the death of Dr. Russell be filled by the appointment of Dr. Roland B. Dixon, of Harvard University. Since the work of the committee is performed in occasional conferences and by correspondence, entailing little expense, no grant is asked for its maintenance.

Respectfully,
W J McGee, *Chairman.*
George Grant MacCurdy.

*On Grants.*

The committee on grants recommends that appropriations for the ensuing year be made as follows, namely:

To the Concilium Bibliographicum of Zurich, $100.

To the Committee on the Atomic Weight of Thorium, $100.

To the Committee on the Study of the Relations of Plants to Climate, $75.

To the Committee on Determination of the Velocity of Light, $75.

To a committee of Section C, to be appointed, to study certain problems in electrochemistry, $60.

To give effect to this last recommendation, the following resolution is suggested:

*Resolved*, That a committee consisting of Professors W. D. Bancroft, Edgar F. Smith and L. Kahlenberg be appointed to conduct said investigations in electrochemistry and that this committee be designated the Committee on Electrochemistry.

*On Policy of the Association.*

The Committee on Policy of the Association reported the following resolutions, which were adopted.

1. Concerning the proposition to authorize the appointment of an executive committee of five to consult with the permanent secretary and arrange details of the meetings, that the functions of such proposed executive committee be performed by the Committee on the Policy of the Association.

2. The Committee on the Policy of the Association recommend to the council that at the next annual meeting only three general sessions be held, namely, those of Monday, Wednesday and Friday of the week of meeting.

3. Amend Article 34 by the omission of the words 'on the election of any member as a fellow an additional fee of two dollars shall be paid.'

4. That the commutation of secretaries of sections be fixed at $30 for each meeting of the association, provided that these secretaries lodge during the whole meeting at the hotel headquarters of the association.

In regard to granting credentials to members of the association who wish to visit foreign associations, the committee recommended that all such applications be referred to the Committee on Policy, with power.

In regard to the application of the Society of College Teachers of Education and of the Society for Horticultural Science for affiliation with this association, the committee recommended that the applications be granted.

*On the Relations of the Journal Science with the Association.*

On the recommendation of the committee it was voted:

1. That the treasurer be added to this committee.

2. That the vice-presidents of the association and the permanent secretary be added to the editorial committee of the journal, SCIENCE.

*On Amendments.*

The following amendments to the constitution having been proposed at the Washington meeting, favorably acted upon by the council and reported to the general session were adopted:

Article 34, second line, change the word *assessment* to the word *dues.*

Article 35, first line, change the word *assessment* to the word *dues.*

Article 37, first line, change the word *assessment* to the word *dues.*

*On Fellows*

The following members were elected fellows of the association: Edward Goodrich Acheson, Victor C. Alderson, J. M. Allen, Frank Marion Andrews, Henry Prentiss Armsby, B. J. Arnold, Luigi d'Auria, Oscar Phelps Austin, Thomas M. Balliet, J. H. Barr, John Mallery Bates, Albert T. Bell, W. Z. Bennett, William B. Bentley, Bernard Arthur Behrend, Samuel Lawrence Bigelow, Charles Edward Brewer, W. K. Brooks, David I. Bushnell, Jr., Sidney Calvert, William E. Castle, Hubert Lyman Clark, Frederic Edward Clements, George E. Coghill, James Milnor Coit, Charles A. Conant, Robert A. Cooley, Henry Crew, William Crozier, Richard Sydney Curtiss, N. M. Fenneman, George Egbert Fisher, Moses Gomberg, Benjamin Feland Groat, Charles M. Hall, Fred DeForest Heald, George Grout Hedgcock, J. S. Hine, Frederick W. Hodge, S. J. Holmes, William Hoskins, Ira Woods Howerth, William James, John Black Johnston, Edwin S. Johonnott, Edward Kasner, Edward Keller, C. A. King, J. S. Kingsley, Martin A. Knapp, Charles M. Knight, Jesse Goad Land, A. S. Langsdorf, F. M. Leavitt, Felix Lengfeld, Victor Lenher, P. M. Lincoln, G. W. Littlehales, George Edwin McLean, Haven Metcalf, Robert Treat Paine, Charles J. Reed, Jacob Reighard, James Ford Rhodes, Isaac W. Riley, Samuel P. Sadtler, E. Dwight Sanderson, Homer LeRoy Shantz, John Lewis Sheldon, Bohumil Shimek, Edward Randolph Taylor, J. Bishop Tingle, Olin F. Tower, J. L. Van Ornum, F. L. O. Wadsworth, S. W. Williston and A. N. Winchell.

The following resolutions were proposed and adopted at the meeting of the general session held Friday, January 1:

In view of the extremely complete and effective arrangements which have guarded and guided the conduct of the multiplied activities of the meeting with such unusual success, and in the thought of the many courtesies which have been extended to us on every hand with most genuine hospitality, it is a peculiar pleasure to be called upon to present for adoption by the association the resolution of thanks which are so incomplete an expression of our appreciation of these privileges. At the same time, each one of us must feel that the most extended enumeration would only partially include the many who have so generously contributed to make this meeting a success in every direction.

First of all, the thanks of the association must be extended to the local committee, and particularly to the honorary president, the Hon. David R. Francis; to the chairman, Professor William Trelease; to the secretary, Professor A. S. Langsdorf; to the treasurer, Mr. William H. Thomson, and to the members of the executive committee, Chancellor W. S. Chaplin, Mr. George H. Morgan, Professor F. E. Nipher, Mr. John Schroers, Mr. Walter B. Stevens, Dr. William Taussig and Mr. H. C. Townsend, who, as chairman of the various subcommittees, have arranged for all the details with such forethought as to keep the machinery of a large and complicated program in operation without friction or interference, and to provide for many outside courtesies of the most enjoyable type.

Sincere thanks are due to the Board of Education for placing at our disposal the Central High School building, so admirably adapted to the purposes of this meeting; to Superintendent of Public Instruction F. S. Soldan; to Principal W. J. S. Bryan and his corps of assistants and students for their untiring efforts in caring for the various sections, and to Messrs. George F. Knox, William Butler and S. A. Douglas for their continued oversight and manipulation of the lanterns and other appliances placed at the disposal of the sections.

The association is deeply indebted to the trustees and director of the Missouri Botanical Gardens

for hospitalities extended to members in connection with their visits to this splendid institution, and for the exceptional courtesies tendered in connection with the Shaw banquet.

The association is under obligations to the officers of the Louisiana Purchase Exposition for the luncheon and reception at the grounds of the exposition, and to the chiefs of departments under whose guidance the members were privileged to witness the progress already made toward the completion of this monumental work.

The association must further acknowledge its indebtedness to the press, to the St. Louis Transit Company, to the president of the Board of Public Improvements and to all other organizations, corporations and individuals who have extended so many privileges to members individually and in groups in connection with visiting the great industries and points of interest in St. Louis and vicinity.

The association is under deep obligations to the Mercantile Club, to the University Club, and finally and in especial measure, to the Wednesday Club for the thoughtful hospitalities extended to the ladies registered at the meeting.

It was unanimously voted to extend the thanks of the association to Professor Rutherford for his lecture on radium and radio-activity.

At the meeting of the general committee, held Thursday evening, it was decided to hold the next meeting in Philadelphia, beginning Tuesday, December 27, 1904, and closing Monday, January 2, 1905, it being understood that the Executive Committee of the Council will meet Tuesday, December 27, and the opening session of the meeting will be held Wednesday, December 28. New Orleans was recommended as the place of meeting two years hence.

The following officers were elected for the Philadelphia meeting:

*President*—W. G. Farlow, Cambridge, Mass.

*Vice-Presidents:*

Section A—Alexander Ziwet, Ann Arbor, Michigan.

Section B—William F. Magie, Princeton, New Jersey.

Section C—Leonard P. Kinnicutt, Worcester, Massachusetts.

Section D—David S. Jacobus, Hoboken, New Jersey.

Section E—Eugene A. Smith, University, Alabama.

Section F—C. Hart Merriam, Washington, D. C.

Section G—B. L. Robinson, Cambridge, Mass.

Section H—Walter Hough, Washington, D. C.

Section I—Martin A. Knapp, Washington, D. C.

Section K—The present vice-president, Mr. H. P. Bowditch, will serve another year.

*General Secretary*—Charles S. Howe, Cleveland, Ohio.

*Secretary of the Council*—Clarence A. Waldo, Lafayette, Indiana.

Charles S. Howe,
*General Secretary.*

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## THE ELEMENTS: VERIFIED AND UNVERIFIED.*

It is the sad duty of the retiring chairman of this section to chronicle the death of two members. One of them, James Francis Magee, B.S., University of Pennsylvania, 1887, devoted his life chiefly to commercial pursuits, in which he was most successful. He joined the association at the fifty-first meeting, being one of the youngest members. The other was H. Carrington Bolton, Columbia, 1862 (Ph.D. Göttingen, 1865), who, with the exception of four (Gibbs, Boye, Brush and Hilgard), was the senior of the section, having joined at the seventeenth meeting. I beg permission to quote from an article of his in the *American Chemist*, 1876, the year following his elevation to fellowship in the association, as it exemplified in telling words one of the great aims in his life, with the fruitful accomplishment of which you are familiar:

"So rapid are the strides made by science in this progressive age and so boundless is its range, that those who view its career from without find great difficulty in following its diverse and intricate pathways, while those who have secured a foot-

* Address of the vice-president and chairman of Section C, Chemistry, of the American Association for the Advancement of Science, St. Louis meeting, December 28, 1903.

ing within the same road are often quite unable to keep pace with its fleet movements and would fain retire from the unequal contest. It is not surprising, then, that those actually contributing to the advancement of science, pressing eagerly upward and onward, should neglect to look back upon the labors of those who precede them and should sometimes lose sight of the obligations which science owes to forgotten generations.''* His numerous contributions to and intimate knowledge of the history of chemistry, his gentle and generous sympathy aided and stimulated many active in research or technical applications of chemistry. His monumental bibliographies put out by the Smithsonian Institution are masterpieces. The grief and keen regret of his loss are not confined to one nation.

On another occasion it has been the good fortune of him who has the honor of addressing you to-day to indicate that events of literary moment, governmental modifications, inventions and forward stridings in science, have apparently accommodated themselves to historical periods during the past century.† Striking, novel facts and fancies, gleaned in the realm of inorganic chemistry, have crested not a few of the high waves of those human tides that beat against the coasts of the untried and unknown.

The human mind knows by contrasts. For the day we have night; for the good there is evil. Where man would have a God, he also had a devil; for the true there is the false; the verified and unverified. The false may be true through ignorance; the true may be false in the light of new knowledge. Or, as Hegel put it, 'Sein und das nicht Sein sind das Nämliche.'

* 'Notes on the Early Literature of Chemistry—The Book of the Balance of Wisdom,' New York Academy of Sciences, May 29, 1876.

† 'The Rare Earth Crusade; What it Portends, Scientifically and Technically,' SCIENCE, N. S., XVII., 722–781.

Is matter continuous or discrete? argued the opposed schools of Grecian philosophy led by Leucippus, Democritus and Epicurus and dominated by Aristotle. Despite the clarity of the statements of the Roman Lucretius,* the atomic hypothesis received scant attention until the seventeenth century of the Christian era, when Galileo's experimental science assailed Aristotelian metaphysics and demanded verification of the premises of that philosophy which had governed all the schools of Europe for two thousand years.† While Gassendi, Boyle, Descartes, Newton, perhaps Boscovich, Lavoisier, Swedeborg, Richter, Fischer and Higgins had to do with our modern atomic theory, Dalton one hundred years ago 'created a working tool of extraordinary power and usefulness' in the laws of definite and multiple proportions. As Clarke‡ remarked, 'Between the atom of Lucretius and the Daltonian atom the kinship is very remote.' Although the lineage is direct, the work of Berzelius, Gmelin and others; the laws of Faraday, Guy Lussac, Avagadro, Dulong and Petit; the reformations of Laurent and Gerhardt, but particularly Cannizzaro; the systematizations of de Chancourtois, Newlands, Hinrichs, Mendelejeff and Lothar Meyer; the stereochemistry of van't Hoff and LeBel have imperialized the ideas of the Manchester philosopher, so that the conceptions of the conservative atomists of to-day are quite different from those at the beginning of the closed century.§

* "Nature reserving these as seeds of things
Permits in them no minish nor decay;
They can't be fewer and they can't be less."

Again, of compounds—

"Decay of some leaves others free to grow
And thus the sum of things rests unimpaired." Book II., 79.

† See 'The Atomic Theory,' the Wilde Lecture by F. W. Clarke at Dalton Celebration, May, 1903.

‡ *Loc. cit.*

§ While I have examined much of the original literature, Venable's 'History of the Periodic

These have not come about solely through the additive labors of the savants mentioned, for they have been shaped quite as much by speculative and experimental opposition exemplified by Brodie* and Sterry Hunt.†

In Graham's 'Speculative Ideas Respecting the Constitution of Matter'‡ we have the conception that our supposed elements possess 'one and the same ultimate or atomic molecule existing in different conditions of movement. § *Apropos,* we have the suggestion of F. W. Clarke || that the evolution of planets from nebulæ, according to the hypothesis of Kant and Laplace, was accompanied by an evolution of the elements themselves. Even Boyle—'the cautious and doubting Robert Boyle,' as Humboldt said of him—was inclined to the belief that 'all matter is compounded of one primordial substance—merely modifications of the *materia prima.*'

The Daltonian ideas had scarcely reached adolescence before Prout (1815), giving heed to the figures concerned, would have all the elements compounded of hydrogen. The classical atomic mass values obtained by sympathetic Stas and the numerous investigations of those who followed him, with all the refinements human ingenuity has been able to devise, temporarily silenced such speculations, but not until Marignac

Law' has been most helpful. I have, furthermore, had the privilege of reading very carefully the manuscript of a work entitled 'The Study of the Atom' (in press), by Dr. Venable.

* 'Calculus of Chemical Operations,' *J. Chem. Soc.*, 21, 367 (1866), and his book, 'Ideal Chemistry,' 1880.

† Numerous papers summarized in 'A New Basis for Chemistry.' New York, 1887 and 1892 (fourth edition).

‡ *Proc. Roy. Soc.*, 1863.

§ Venable, 'The Definition of the Element,' vice-presidential address, Section C, American Association for the Advancement of Science, Columbus meeting, 1899.

|| 'Evolution and the Spectroscope,' *Pop. Sc. M. Jour.*, 1873.

had halved the unit, Dumas had quartered it, and Zängerle, as late as 1882, insisted upon the one thousandth hydrogen atom.

The notion, like Banquo's ghost, will ever up, for if one may judge from the probability calculations of Mallet* and Strutt,† a profound truth underlies the now crude hypothesis.

Crookes,‡ from observations made during prolonged and painstaking fractionations of certain of the rare earths, supported his previously announced 'provisional hypothesis' as to the genesis of the elements from a hypothetical *protyle,* which existed when the universe was without form and void. He designated those intermediate entities, like yttrium, gadolinium and didymium, 'meta-elements,'§ a species of compound radicals, as it were. *Urstoff*, fire mist, protyle, the ultra-gaseous form, the fourth state of matter || was condensed by a process analogous to cooling; in short, the elements were created. The rate of the cooling and irregular condensation produced 'the atavism of the elements,' and this caused the formation of the natural families of the periodic system. Marignac¶ criticizing this hypothesis, states: "I have always admitted** the impossibility of accounting for the curious relations which are manifested between the atomic weights of the elements, except by the hypothesis by a general method of formation according to definite though unknown laws; even when these relations have the character of general and absolute laws."

Further, "I do not the less acknowledge

* *Phil. Trans.*, 171, 1003, 1881.

† *Phil. Mag.* (6), 1, 311.

‡ *Chem. News*, 55, 83, 1886.

§ Address before Chemical Section of the British Association, *Chem. News*, 54, 117, 1885.

|| Crookes, Royal Societies, June 10, 1880.

¶ *Archives des Sciences Physiques et Naturelles*, 17–5; *Chemical News*, 56, 39.

**Remarks made in 1860–5 after publication of Stas's 'Researches on Atomic Weights,' Archives, 9, 102, 24–376.

that the effect of constant association of these elements is one of the strongest proofs that can be found of the community of their origin. Besides, it is not an isolated fact; we can find other examples such as the habitual association in minerals of tantalum, niobium and titanium.''

Sir John Herschel thought that all the atoms were alike and the elements, as we know them, 'have the stamp of the manufactured article.'

Hartley* this year says: 'It is more than twenty years since the study of homology in spectra led me to the conviction that the chemical atoms are not the ultimate particles of matter, and that they have a complex constitution.'

The peculiar discharge from the negative electrodes of a vacuum tube was investigated many years ago by Hittorf and Crookes, who arrived at the conclusion that it was composed of streams of charged particles. All are familiar with the very recent proposed 'electrons' and 'corpuscles' resulting from the beautiful physical researches of Lodge and J. J. Thomson. These appear to have caused a trembling in the belief of many in the immutability of the atom, and the complete abandonment of the atom is seriously discussed by others.

''If the electrons of all elements are exactly alike, or, in other words, if there is but one matter, just as there is but one force, and if the elements be but the various manifestations of that one matter, due to a different orbital arrangement of the electrons, it would seem that we are fast returning to the conceptions of the middle-aged alchemist. The transmutation of metals involves but the modification of the arrangement of the electrons.'' Such efforts as Fittica's* should not be treated with scorn, but given careful examination and merited consideration, as Winkler† gave his. Science should thus ever be 'a foe of raw haste, half-sister to delay.'‡

* Address before the Chemical Section, British Association, Southport meeting, September, 1903, *Chem. News*, 88, 154.

Although by chemical means, so far, we have been unable to break up the atoms, apparently electrical energy, in the form of cathode rays, for example, follows the grain of atomic structure. Some advanced thinkers look upon the atoms as disembodied charges of electricity. Ostwald has taught it. Electric charges are known only as united to matter, yet Johnstone, Stoney and Larmor have speculated on the properties of such charges isolated. ''Such a charge is inertia, even though attached to no matter, and the increase of inertia of a body due to electrification has been calculated by both Thomson and Oliver Heaviside, the conception accordingly being advanced that all inertia is electrical and that matter, as we know it, is built up of interlocked positive and negative electrons. If it were possible in any mass of matter to separate these electrons then matter would disappear and there would remain merely two enormous charges of electricity.'' We are aware of phenomena attributed to the negative electrons; we await anxiously the announcement of the positive electrons. But here the water is deep and one may not swim too well.

We do know, however, as A. A. Noyes says,§ that 'there exists in the universe some thing or things other than matter which, by association with it, give rise to the changes in properties which bodies exhibit, and give them power of producing changes in the properties of other bodies.'

* 'Black Phosphorus, or Conversion of Phosphorus into Arsenic,' *Chem. News*, 81, 257; 82, 166.

† *Berichte*, 33, 10; *Chem. News*, 81, 305.

‡ Van Dyke in 'The Ruling Passion.'

§ 'General Principles of Physical Science,' p. 13, 1902.

Further (p. 15), "* * * matter is that which gives rise to the localization of the complex of properties which certain portions of space exhibit. Even though, on the one hand, it must be admitted that the existence of matter is inferred only from various energy manifestations which bodies exhibit, it must be acknowledged, on the other, that there are no manifestations of energy except those which are associated with the manifestations of it that have led to the adoption of the concept of matter; in a word, the two assumed entities, matter and energy, are indissolubly connected in our experience." Thus, as Dumas said, 'Hypotheses are the crutches of science to be thrown away at the proper time.'

I have dared to sketch these conceptions in a few bold outlines, for

> "We can't enumerate them all!
> In every land and age have they
> With honest zeal been toiling on,*
> To turn our darkness into day."

The imposition upon your good nature practiced in the foregoing craves its pardon in an effort to seek a definition for the term, element. Shall we say, as does Remsen, 'An element is a substance made up of atoms of the same kind?' Can we say that it is not? Venable† truly says: 'An element is best defined by means of its properties.' These conceits are not exclusive. The properties are the result of the action of physical forces and chemical affinity, whatever that may be. Certain of the novel atmospheric gases have so far responded but poorly to the latter, as predicted before their discovery by Flawitzsky, Julius Thomsen and de Boisbaudran in 1887. This necessitates, according to Piccini‡ our dividing them at once into two classes.

* Aikens' poem at Priestley centennial, *Am. Chemist*, 1875, 23.

† The 'Definition of the Element,' *loc. cit.*

‡ *Zeit. Anorg. Chem.*, 19, 295, 1899.

Pattison Muir gives a satisfactory definition.* "The notion of the elements that has been attained after long, continued labor is that of certain distinct kinds of matter, each of which has properties that distinguish it from every other kind of matter, no one of which has been separated into portions unlike the original substance, and which combine together to produce new kinds of matter that are called compounds." The following simpler definition has finally served as my guide: *An element is that which has not been decomposed, so far as we are aware, into anything other than itself.* In short, it is consistent.

It is well to stop occasionally and take stock. The Daltonian centenary could not but be an opportune time. Stable, certified securities are not enumerated in the list which follows. Having in mind the second chapter of the first book of Chronicles, certain so-called elements are mentioned, for yttrium begat cerium, and cerium begat lanthanum, and lanthanum begat samarium and didymium, and didymium begat neodidymium and præseodidymium, and præseodidymium begat $\alpha$- and $\beta$-præseodidymium, *'und so weiter.'*

Unpractised as a reading clerk, I shall spare you the strain of hearing this long list of elements on probation, but submit for leisure perusal printed copies which will form an appendix to the address as published in the *Proceedings* of the association.

From the table have been omitted urstoff, protyle (Crookes), electrons (Lodge), corpuscles (J. J. Thomson) and pantogen (Hinrichs). It appeared also unnecessary to incorporate phlogiston, nitricum (the imaginary body, thought by Berzelius united with oxygen to form nitrogen), and aræon (ponderable caloric). According to

* 'The Alchemical Essence and the Chemical Element,' London, 8vo, pp. 94, 1894.

Meissner, hydrochloric acid is composed of two equivalents of oxygen, one of water, combined with aræon and the imaginary radical murium (*vide* Bolton). Often alloys have been prepared and given names like the elements, 'magnalium,' for example. These are omitted also. Otherwise, I have purposely included every suggestion of an element I could obtain. The summary, while doubtless deficient, may secure an historical vindication.

What shall we do with these numerous aspirants whose recognition is urged? "These elements perplex us in our researches, baffle us in our speculations and haunt us in our very dreams. They stretch like an unknown sea before us, mocking, mystifying and murmuring strange revelations and possibilities," said Crookes, referring to the rare earths. Some have been verified, many unverified; some are true, some are false. Without doubt some have been presented without sufficient stage setting, yet the good faith of many can not be questioned. In fact, from this list, as one reads, he perceives the whole gamut of scientific emotions. There he may find the tragedies of elemental pretension, the comedies, yea, the very farces.

We need not look far to ascertain explanations for certain incorrect conclusions. The extreme rarity of the minerals in which many of the tentative elements have been detected, the excessively small percentages of the new ingredients, and the extraordinary difficulties attending their separation from known and unknown substances combine to render the investigations laborious, protracted and costly. De Boisbaudran required 2,400 kilograms of zinc blend for 62 grams of gallium. Ramsay* has shown one part of crypton in twenty million volumes of air, while a like amount of xenon requires one hundred and seventy million. How patiently and persistently that modest Parisian couple followed Becquerel's rays!

* *Zeit. phys. Chem.*, 44, 74, 1903.

Furthermore, when one feels that he has obtained something novel, the absolute proof is fraught with difficulties and uncertainties. We have decided to define an element by its properties. The alterations produced in the properties of the most characteristic elements by the presence of small amounts of foreign substances are evident in steel. The influence of arsenic upon the conductivity of copper is well known, and Le Bon* has recently shown that traces of magnesium (one part in 14,000) in mercury cause the latter to decompose water and to oxidize rapidly in the air at ordinary temperatures. Thorium with less than a trace of actinium produces an auto-photograph.

This point can not be too strongly stressed in the rare earth field. One who has wrought with thorium dioxide well knows the influence a small amount of cerium has upon its solubility. The conflicting statements in the literature as to the colors of the oxides of the complexes, neodidymium and præseodidymium, cause one to wonder if different researchers have had the same hæcceity.

An appeal to the spectroscope is of course in the minds of all my hearers.

It was once supposed that each element has its characteristic spectrum which remained the same under all circumstances. Keeler† calls attention to modern investigations which have shown that the same element can have entirely different spectra. For example, oxygen may be caused to have five different spectra; nitrogen, two, etc. In fact, there is no indication in the appearance of the spectra that they belong to the same substance; yet through the result of the work of Rydberg, Kayser, Runge and

* *Compt. rend.*, 131, 706, 1900.

† *Scientific American Supplement* 88, 977, 1894, and *Popular Astronomy*.

Precht, series of groups of lines are had which satisfy mathematical formulæ.

"It was proposed by de Gramont, at the International Congress in Paris, in 1900, and agreed, that no new substance should be described as an element until its spark spectrum had been measured and shown to be different from that of every other known form of matter." As Hartley * remarks, 'This appears to me to have been one of the most important transactions of the congress.' Radium † was the first to be tested by this rule. Exner and Haschek obtained 1,193 spark and 257 arc lines for Demarçay's europium. It must not be forgotten, however, that by overlapping, lines in mixtures may be masked or appear, which are absent, in those bodies of the highest state of purity. It must not be forgotten that pressure influences the spectrum, usually producing a broadening of the lines, as shown by Schuster, and that it may occur symmetrically or only towards the least refrangible red. Lest we forget, the spectroscope failed a long time to show radium and we knew it was there. It must not be forgotten, as Krüss§ has shown, that the 'influence of temperature can not be neglected and ignored, but must be considered by every chemist who wishes to make correct spectroscopic observations.' It is well known to spectroscopists that band spectra are obtained at temperatures intermediate between those required for the production of continuous spectra and line spectra.|| The explanations of these facts do not concern us at present.

It has been shown by the researches of Newton, Dale, Gladstone, Jamin, Schrauff, Landolt and others that the refractive power increases in all liquids, except in water, between 0° and 4° with the increase of density—that is, with decrease of temperature. Rydberg showed that various solid bodies, such as quartz and aragonite, follow the same law. There are some exceptions, however. Among these is glass, as proved by Arago and Neumann prior to Rydberg. "On a rise of temperature all phenomena of absorption or emission are displaced toward the violet with the glass prisms, but toward the red with quartz prisms. These displacements are the greater the more refrangible the region of the spectrum in which they occur." As the result of a large number of observations, Krüss learned that by a variation of 25°, marked changes would be observed in the spectroscopic lines. From a table given, it could be seen that errors may spring from neglect of the temperature (of the instrument?) in stating wave-lengths, since a rise of 5° is sufficient to transfer the $D_1$ to the position $D_2$. Roscoe obtained an entirely new spectrum with the metal sodium, whereby it appears that this metal exists in a gaseous state in four different degrees of aggregation, as a simple molecule, and as three or four or eight molecules together.

Grünwald in a series of papers on his theory of spectrum analysis* endeavors "to discover relations between the spectra and thus to arrive at simpler, if not fundamental 'elements.'" He came to the conclusion that 'all the so-called elements are compounds of the primary elements *a* and

* Address before the Chemical Section of the British Association, Southport, 1903.

† Runge and Precht, *Am. Physik.*, IV., 12, 407, 1903.

‡ British Association, *Report*, 1880, 275. *Vide* also Lockyer and Frankland, *Proc. Roy. Soc.*, 27, 288, 1869.

§ 'The Influence of Temperature upon the Spectrum; Analytical Observations and Measurements,' *Liebig's Annalen*, 238, 57; *Chem. News*, 56, 51.

|| 'Spectrum Analysis,' Landauer, English translation by Tingle, p. 70.

* 'Über das Wasserspectrum, das Hydrogen— und Oxygenspectrum,' *Phil. Mag.*, 24, 304, 1887. 'Math. Spectralanalyse des Magnesiums und der Kohle,' *Monatshefte für Chemie*, 8, 650. 'Math. Spectralanalyse des Kadmiums,' *Monatshefte für Chemie*, 9, 956.

$b'$ (coronium and helium). Ames,* having called attention to the use of uncorrected data by Grünwald, remarks: 'The concave grating gives the only accurate method of determining the ultra-violet wave-lengths of the elements; and as a consequence of not using it, most of the tables of wave-lengths so far published are not of much value.'

Hutchins and Holden,† after a comparative study of the arc spectra of metals and the sun with a twenty-one-foot focal Rowland grating, state: "We are convinced that there is much in the whole matter of coincidences of metallic and solar lines that needs reexamination; that something more than the mere coincidence of two or three lines out of many is necessary to establish even the probability of the presence of a metal in the sun. With the best instruments the violet portion of the solar spectrum is found to be so thickly set with fine lines that, if a metallic line were projected upon it at random, in many places the chances for a coincidence would be even, and coincidences could not fail to occur in case of such metals as cerium and vanadium, which give hundreds of lines in the arc."

"Moreover, a high dispersion shows that very few lines of metals are simple and short, but, on the contrary, winged and nebulous, and complicated by a great variety of reversal phenomena. A 'line' is sometimes half an inch wide on the photographic plate, or it may be split into ten by reversals."

Lockyer maintained that the lines of certain brilliant substances vary not only in length and in number, but also in brilliancy and in breadth, depending upon the quantity of the substance as well as temperature.* Being unable to decompose the elements in the laboratory, he studied the spectra of the stars. The spectra of the colder stars† show many more metals, but no metalloids, whereas the coldest stars, *A. Orionis,* show the Crookes spectrum of metalloids which are compounds. None of the metalloids are found in the spectrum of the sun. Over 100,000 visual observations and 2,000 photographs were made in the researches.

Liveing,‡ as the result of the work of Young, Dewar, Fievez and himself on the spectrum of the sun, by which some lines were resolved with a new instrument, which they before had not been able to devise, comments on Lockyer's work: That the coincidence of rays emitted by different chemical elements, especially when developed in the spark of a powerful induction coil, and the high temperature of the sun and stars, gives evidence of a common element in the composition of the metals which produce the coincident rays. "This result can not fail to shake our belief, if we had any, in the existence of any common constituent in the chemical elements, but it does not touch the evidence which the spectroscope affords us that many of our elements, in the state in which we know them, may have a very complex molecular structure."

Hartley§ in his recent admirable address said:

"I have always experienced great difficulty in accepting the view that because the spectrum of an element contained a line or lines in it which were coincident with a line or lines in another element, it was evidence of the dissociation of the elements into simpler forms of matter. In my opinion, evidence of the compound nature of the

* *Am. Chem. J.*, 11, 138, 1889.

† 'On the Existence of Certain Elements, Together with the Discovery of Platinum, in the Sun,' *Am. Jour. Sci.; Sci. Am. Supp.*, 25, 628, 1888.

* *Roy. Soc. Proc.*, 61, 148, 183; *Chem. News*, 79, 145.

† *Chem. News*, 79, 147.

‡ Address before the Chemical Section of the British Association, *Scientific American Supplement*, 14, 356, 1882.

§ *Loc. cit.*

elements has never been obtained from the coincidence of a line or lines exclusively belonging to the spectrum of one element with a line or lines in the spectrum exclusively belonging to another element. This view is based upon the following grounds: (1) Because the coincidences have generally been shown to be only apparent, and have never been proved to be real; (2) because the great difficulty of obtaining one kind of matter entirely free from every other kind of matter is so great that where coincident lines occur in the spectra of what have been believed to be elementary substances, they have been shown from time to time to be caused by traces of foreign matter, such as by chemists are commonly termed impurities; (3) no instance has ever been recorded of any homologous group of lines belonging to one element occurring in the spectrum of another, except and alone where the one has been shown to constitute an impurity in the other; as, for instance, where the triplet of zinc is found in cadmium and the triplet of cadmium in zinc the three strongest lines in the quintuple group of magnesium is graphite, and so on. The latest elucidation of the cause of coincidences of this kind arises out of a tabulated record from the wave-length measurements of about three thousand lines in the spectra of sixteen elements made by Adeney and myself. The instances where lines appeared to coincide were extremely rare; but there was one remarkable case of a group of lines in the spectrum of copper which appeared to be common to tellurium; also lines in indium, tin, antimony and bismuth which seemed to have an origin in common with those of tellurium."

The last sentence presents the point I wish to emphasize. Tellurium has long obtruded itself before a satisfactory vision of the natural system. The table alone recites not a few efforts to obtain the contaminating constituent of tellurium which *a priori* is present from Hartley's observations (see also Grünwald 1889 table). The fractionation of a rubidium-cæsium mixture, perhaps, is a simpler problem than that confronting Pellini,* who reports a definite amount of an element with a high atomic weight (about 214), similar to and associated with tellurium.

* *Gaz. Chim. ital.*, 33, 11, 35.

What has been said applies especially to the elements of the rare earth class —'asteroids of the terrestrial family'—as phrased by Crookes. Many of them have not been secured with sufficient purity to claim an inherent spectrum; further, the spectra attributed have not been obtained under uniform conditions.

I have referred* somewhat in detail elsewhere to the factors producing variations in the absorption, as well as the advantages and disadvantages of the phosphorescent and reversal, spectra.

Without doubt the spectroscopic criteria are the most valuable we have in judging finally the elements, and mayhap will remain so, but in my humble opinion, such have not alone sufficient authority, as yet, to usher the aspirant to a place among the elect. The contention frames itself, however, in an expression of the need for uniformity.

Whether we follow the most advanced metaphysico-chemical teachings or no, if there be any one concept upon which modern practical chemical thought depends, it is the law of definiteness of composition. There may be, and doubtless are, definite, perhaps invariable, properties of our elements other than their combining proportions, the atomic weights, if you please, yet, as far as we know, they approximate more closely than any fixed, if not permanent, ratios. Many of these values, by which we lay such store, are dependent upon data† in which, I venture the assertion, too great confidence has been bestowed, or opinions to which sufficient attention has not been given.

Although in this connection we shall give little heed to the suggested variability of the relative values, it may be remarked that Boutlerow, noting the variations ob-

* 'The Rare Earth Crusade,' *loc. cit.*

† Others have been referred to in the address to which this is a sequel. *Loc. cit.*

served in 1880 by Schützenberger, who, by the use of different atomic weights, obtained analyses summing 101 instead of 100, expressed the opinion that the chemical value of a constant weight, or rather mass of an element, may vary; that the so-called atomic weight of an element may be simply the carrier of a certain amount of chemical energy which is variable within narrow limits. (See also Crookes.) Wurtz's summary of Boutlerow's views, at a meeting of the Chemical Society of Paris, provoked an interesting discussion. Cocke later published a statement that he had expressed similar views more than twenty-five years before. That is, in 1855, he had questioned the absolute character of the law of definite proportions and had suggested that the variability was occasioned by the very weak affinity between elements manifesting a fluctuating composition. Without doubt 'The Possible Significance of Changing Atomic Volume,'* in which a suggestion as to the probable source of the heat of chemical combination is put forward by T. W. Richards, bears directly upon this phase of the problem.

While the atomic mass values depend directly upon the ratio between the constituents of the compounds, they rest equally upon the molecular weights. Many of the latter attributed to salts of some of the rare earths depend solely upon the specific† heat determinations of Hillebrand and Norton,‡ Nilson and Pettersson,§ who, in the light of subsequent investigations, we know, worked with complexes. To be sure, those elements which were apparently exceptions to the law of Dulong and Petit, possess low atomic weights (beryllium, boron, carbon, silicon, aluminum and sulphur) and have for the most part been brought into harmony. "The specific heats of all substances vary with the temperature at which they are measured; and though the variation is often slight, it is occasionally of relatively great dimensions. When this is so in the case of an element, the question arises: At what temperature must the measurement of the specific heat be made in order to get numbers comparable with those of the other elements? No definite answer has been given to this question, but it is found that as the temperature rises, the specific heat seems to approach a limiting value, and this value is not in general far removed from that which would make the atomic heat approximately equal 6.4."* In view of this, allotropism, and the work of Richards adverted to, it appears that a revision of the specific heat values now taken is necessary before we can accept fully this law, which has been most helpful.

Time will not admit of detailed statements, and it is unnecessary in this presence to more than call attention to the fact that what has been said is not applicable to each specific case. *'La critique est facile, mais l'art est difficile,'* as Berthelot† has said, yet we must appreciate that all our laws have their limitations. "Man being servant and interpreter of nature, can do and understand so much and so much only, as he has observed in fact or in thought in the course of nature. Beyond this he neither knows anything nor can do anything."‡

A glance at the extensive, even censored, list of claimants will evoke serious thought. "Thus was the building left ridiculous."§ The difficulties briefly outlined and the causes for lack in uniformity are by no means insurmountable, but will continue

* *Proc. Am. Acad. Arts and Sciences*, 27, 1, 1901, and 27, 399, 1902.

† *Berichte*, 13, 1461, 1880.

‡ *Pogg. Annal.*, 156 and following.

§ *Berichte*, 13, 146, 1880.

* 'Introduction to Physical Chemistry,' James Walker, London, p. 33.

† 'Les Origines de l'Alchimie,' Paris, 1885.

‡ Bacon's 'Novum Organum,' Aphorism I.

§ Milton, 'Tower of Babel.'

until more systematic direction and prosecution of the work come about. Investigators in pure chemistry as a rule hold professorships, or other positions making equal demand upon their time. Furthermore, it is extremely rare that one man can become a master of the various delicate operations hinted at. Mallet* made a proposition for systematizing atomic weight work and F. W. Clarke in this country† and abroad‡ has urged the establishment of an institute for its prosecution. This appeals to all interested in what we are pleased to term the exact sciences, and doubtless in time will come about. For the time being, however, it is not unreasonable to suppose that a concerted appeal of the chemists of this country to the direction of the munificent endowment recently made American science for funds to clarify the elemental enigma presented above would not be in vain. There are splendidly equipped chemical departments in some of our great American universities which would make room for, and cordially welcome, I am sure, a selected corps of supported researchers, who would test the claims of each of these and other elemental aspirants. Such a community of effort should receive even greater substantial assistance from governments and corporations than has been accorded individuals. I need only refer to the aid given the Curies by the Austrian government, and generosity shown by the Welsbach Lighting Company in this country to several investigators, especially myself.

It must be evident to all that we are not indulging in special pleading, for every phase of that division of science designated chemistry rests upon what we choose to term the elements.

* Stas memorial lecture, Chemical Society (London), delivered December 13, 1892.

† Presidential address before the American Chemical Society.

‡ Wilde lecture at the Dalton Centenary, Manchester, 1903.

Victor Meyer,* referring to the phantasies of science, said: "He, however, who only knows chemistry as a tradition of perfectly clear facts, or who thinks to see the real soul of chemical study in measuring physical phenomena which accompany chemical transformations, feels no breath of this enjoyment." Reflecting upon the good and ill that have come to us through unrestrained imagination, we may give a careful acceptance of Newton's 'Physics, beware of metaphysics' for as Clifford wrote, 'Doubtless there shall by and by be laws as far transcending those we know as they do the simplest observations.'

The graphic representation of the elements, 'the foundation stones of the material universe which amid the wreck of composite matter remained unbroken and unworn,' as Maxwell gracefully spoke of them, has often been mistaken for the periodic law. Carnelley's 'reasonable explanations' of the periodic law were given a respectful hearing and forgotten.†

"Granting that the chemical characteristics of an element are connected with its atomic weight, we have, however, no right to assume them to be dependent upon that fact alone" (Liveing). Hinrichs says weight and form,‡ concerning the latter of which I am ignorant. No doubt the pendulum lately has swung back toward Berzelian thought revivified by the like masters, van't Hoff and Arrhenius.

Le Verier predicted the planet Neptune

* Lecture on 'The Chemical Problems of To-day' before the Association of German Naturalists and Physicians at Heidelberg, September, 1889; *Chemical News*, 61, 21.

† He regarded the elements as compounds of carbon and ether analogous to the hydrocarbon radicals, and suggested that all known bodies are made up of three primary elements—carbon, hydrogen and ether—truly an assumption which can not be disproved. Aberdeen meeting, British Association.

‡ 'Atom Mechanics,' Hinrichs, Vol. I., St. Louis, 1894, p. 242.

and his predictions were verified. While all of Mendelejeff's predictions, specific and tacit, have not been verified, some have. Ramsay* and others, without a periodic guide, predicted certain of the inert gases, which predictions have been verified.

Victor Meyer, in speaking of the completion of the Mendelejeff table, calls attention to the summing up of one hundred elements, from which it appears that 258 would be the limit to our atomic mass equivalents. I am not prepared positively to contradict such a conclusion at the present time, but there are reasons for thinking otherwise.

Clarke† has shown that the mean density of the earth, 5.5 to 5.6, is more than double that of the rocky crust, and 'the difference may be accounted for as a result of pressure, or by supposing that, as the globe cooled, the heavier elements accumulated towards the center.' While it is quite impossible to judge of the order of this intramundane pressure, I am not aware of such marked changes being brought about in the specific gravities of the heavier solid elements of their compounds, either by pressure, allotropic or isomeric changes, except the cerebral argentaurum of the late S. H. Emmens.‡ The examinations of volcanic dusts by Hartley,§ Fleet|| and others appear to contradict the latter explanation, although we are unable to state the depth, perhaps within the shell considered by Clarke, at which volcanoes begin their boisterous activity. While awaiting a fulfillment of Martinez's* project to explore the earth's center, we may offer a third solution, not wholly unscientific, as it can do no harm, and has nought to do with any yellow peril in science, namely, the existence of elements with atomic weights higher than those set by the silent limit of periodic tables.

"Most molecules—probably all—are wrecked by intense heat, or, in other words, by intense vibratory motion, and many are wrecked by a very impure heat of the proper quality. Indeed, a weak force, which bears a considerable relation to the construction of the molecule, can by timely savings and accumulation accomplish what a strong force out of relation fails to achieve."†

As hinted at in the earlier portion of this unduly prolonged address, many have theorized as to the ultimate composition of matter. The logic of Larmor's‡ theory, involving the idea of an ionic substratum of matter, the support of J. J. Thomson's§ experiments, the confirmation of Zeeman's phenomenon, the emanations of Rutherford, Martin's|| explanations, can not fail to cause credence in the correctness of Crookes's idea of a fourth state of matter.¶ In the inaugural address as president of the British Association (1898), he acknowledges in the mechanical construction of the Roentgen ray tubes a suggestion by Silvanus Thompson to use for the anticathode a metal of high atomic weight. Osmium and iridium were used, thorium tried, and in 1896 Crookes obtained better results with metallic uranium than platinum.

These and the facts that most of the elements with high atomic weights, in fact

* Address before the Chemical Section, British Association, Toronto meeting (1898).

† 'The Relative Abundance of the Chemical Elements,' F. W. Clarke, read before the Philosophical Society of Washington, October 26, 1899; *Chem. News*, 62, 31.

‡ Argentaurum papers published by Emmens, New York.

§ Royal Society, February 21, 1901; *Chem. News*, 83, 174.

|| Abstr. *Proc. Geol. Soc.*, 1902, 117; *Journ. Chem. Soc.* (Land), 81–82, ii., 518, 1902.

* 'La Nature,' *Sc. Am. Sup.*, 21, 546, 1886.

† Tyndall in *Longman's Magazine.*

‡ *Phil. Mag.*, December, 1897, 506.

§ *Phil. Mag.*, October, 1897, 312.

|| *Chem. News*, 85, 205, 1902.

¶ *Phil. Trans.*, II., 1881, 433.

all above 200 (thallium not reported on),* exhibit radio-active properties, are doubtless closely associated and have to do with the eventual composition of matter. I have unverified observations which go to show the existence of at least one element with a very high atomic weight. If it be confirmed, then we have them now or they are making, and probably breaking up, as shown by that marvelous class of elements in the discovery of which the Curies have been pioneers.

If our ideas that all known elements come from some primordial material be true, then it stands to reason that we are coming in time, perhaps, to that fixed thing, a frozen ether, the fifth state of matter. I may make use of dangerous analogy and liken our known elements, arranged in a perfected natural system, to the visible material spectrum, while electrons, etc., constitute the ultra-violet and *cosmyle* composes the infra-red, either one of the latter by proper conditions being convertible into perceptible elemental matter. No positive evidence supports these ideas, but I like to fancy scientific endeavor as the sea—calm and serene, supporting and mirroring that which is below it, bearing that which is upon it, reaching to and reflecting that which is above it, moving all the while; yet, torn and rent at times by conflict from without and contest within, it runs; it beats against the shores of the unknown, making rapid progress here, meeting stubborn resistance there, compassing it, to destroy but to rebuild elsewhere; and the existence of those within it! 'Like that of Paul, our life should be a consecrated unrest.'

CHARLES BASKERVILLE.

* See the exquisite paper by Madame Curie on 'Radioactive Substances,' also 'Radio-active Lead,' Hofmann and Strauss, *Berichte*, 34, 3033, Pellini (*loc. cit.*) on 'Radio-active Tellurium'; Strutt, *Phil. Mag.*, 6, 113, Elster and Geitel, Giesel, Marckwald, etc., etc.

## *MEETINGS OF AFFILIATED SCIENTIFIC SOCIETIES AT PHILADELPHIA.*

THE Association of American Anatomists, the Society of American Bacteriologists, the Society for Plant Morphology and Physiology, the American Physiological Society, the American Society of Zoologists (Eastern Branch), the American Society of Vertebrate Paleontologists, met in Philadelphia, Pa., December 28–31, 1903. All of these societies except the last, which was organized only one year ago, have heretofore been affiliated with the American Society of Naturalists, and, with the exception of the annual discussion and dinner which the Society of Naturalists holds, the meetings this year were wholly similar to those which have been held by these societies during the past ten or twelve years.

On Monday evening there were informal meetings of the members of the various societies. The Society for Plant Morphology and Physiology was given a reception at Biological Hall, University of Pennsylvania; the American Physiological Society held a smoker at the Hotel Walton, while the other societies held smokers at the 'Rathskellar.'

Tuesday morning and afternoon, sessions of all the societies were held at the University of Pennsylvania, and all the societies except the physiologists held morning and afternoon sessions there on Wednesday also. The Physiological Society met on Wednesday at Jefferson Medical College. Luncheon was served by the University of Pennsylvania to all the societies on Tuesday and to all except the physiologists on Wednesday; on this day the latter society was entertained at luncheon at the Philadelphia Club.

Tuesday evening all the societies were the guests of the local committee at a smoker at the University Club.

Wednesday evening a lecture was given

before the members of the various societies at the Academy of Natural Sciences by Professor W. B. Scott, on 'The Miocene Fauna of Patagonia and the Problem of the Southern Hemisphere.' After the lecture a brilliant and most enjoyable reception was given to the members of the societies by Dr. and Mrs. Horace Jayne.

About two hundred members of the various societies attended the meetings, and the papers presented were numerous and, in some of the societies at least, more than usually interesting.

The following officers were elected for the ensuing year:

*Association of American Anatomists: President*, Professor Charles S. Minot, of Harvard University; *First Vice-President*, Professor George A. Piersol, of the University of Pennsylvania; *Second Vice-President*, Professor J. M. Flint, of the University of California; *Secretary and Treasurer*, Dr. G. Carl Huber, of the University of Michigan; *Executive Committee*, Dr. Franklin P. Mall, Dr. George S. Huntington.

*Society of American Bacteriologists: President*, Dr. F. G. Novy, of the University of Michigan; *Vice-President*, Dr. E. O. Jordan, of the University of Chicago; *Secretary and Treasurer*, Dr. F. P. Gorham, of Brown University. Dr. William H. Welch was elected a delegate to the Council of the American Association for the Advancement of Science.

*Society for Plant Morphology and Physiology: President*, Dr. G. T. Moore; *Vice-President*, Professor Clara E. Cummings; *Secretary and Treasurer*, Professor W. F. Ganong.

*American Physiological Society: President*, Professor Russell H. Chittenden, of Yale University; *Secretary and Treasurer*, Professor Frederic S. Lee, of Columbia University; *Members of Council*, Professor William H. Howell, of Johns Hopkins University; Professor Warren P. Lombard, of the University of Michigan; Professor William T. Porter, of Harvard University; Professor Frederic S. Lee, of Columbia University.

*American Society of Zoologists, Eastern Branch: President*, Professor E. A. Andrews, of Johns Hopkins University; *Vice-President*, Professor W. E. Castle, of Harvard University; *Secretary and Treasurer*, G. A. Drew, of the University of Maine; *Executive Committee*, Professor H. S. Jennings, of the University of Pennsylvania; T. H. Montgomery, Jr., of the University of Texas; H. C. Bumpus, of the American Museum of Natural History.

*American Society of Vertebrate Paleontologists: President*, Professor Henry F. Osborn, of Columbia University and the American Museum of Natural History; *Secretary*, Dr. O. P. Hay, American Museum of Natural History; *Executive Council*, Professor Bashford Dean, of Columbia University; Professor Loomis, of Amherst College; Dr. C. R. Eastman, of Harvard University.

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## *AMERICAN MATHEMATICAL SOCIETY.*

THREE meetings of the American Mathematical Society were held during the Christmas holidays. On December 19 the San Francisco Section met at the University of California; the annual meeting of the society was held at Columbia University, December 28–29; and the winter meeting of the Chicago Section was held at St. Louis, in connection with that of the American Association for the Advancement of Science December 31 to January 1.

Reports of the sectional meetings will appear in a later number of SCIENCE. At the annual meeting in New York officers for the society for 1904 and members of the council to serve for three years were elected as follows:

*Vice-Presidents*—Oskar Bolza and J. M. Van Vleck.

*Secretary*—F. N. Cole.

*Treasurer*—W. S. Dennett.

*Librarian*—D. E. Smith.

*Committee of Publication.*—F. N. Cole, Alexander Ziwet, D. E. Smith.

*Members of the Council*—Maxime Bôcher, Florian Cajori, M. B. Porter, J. H. Tanner.

The president of the society, Thomas S. Fiske, continues in office, the presidential term being two years.

The following persons were elected to membership in the society: R. F. Deimel, Columbia University; C. S. Forbes, Columbia University; O. T. Geckeler, Georgia School of Technology; E. A. Hook, Columbia University; L. A. Martin, Jr.,

Stevens Institute of Technology; Miss Virginia Ragsdale, New York City; S. E. Rasor, Ohio State University; A. E. Young, Purdue University; J. E. Wright, Bryn Mawr College. Six applications for membership were received.

Annual reports were received from the treasurer, librarian and secretary. The society continues to hold its own financially. It could accomplish more if larger funds were at its disposal. The library has increased to over 1,300 volumes, and now receives by exchange with the *Bulletin* and *Transactions* the current volumes of nearly every mathematical journal in the world. The membership of the society is now 455, a gain of 54 during the past year. The 'Annual Register' will be issued about the middle of January.

Committees were appointed to arrange for the publication of the course of lectures delivered at the Boston colloquium, September, 1903, and to consider the question of the future financial support of the *Transactions,* which has hitherto been published by the aid of subventions terminating in 1904.

The following papers were read at the annual meeting:

E. V. Huntington: 'A set of independent postulates for the algebra of logic (second paper).'

J. G. Hun: 'On certain invariants of two triangles.'

O. D. Kellogg: 'Note on Cauchy's integral.'

J. I. Hutchinson: 'On certain automorphic functions.'

W. F. Osgood: 'On a gap in the usual presentation of Weierstrass's theory of functions.'

E. V. Huntington: 'Third complete set of postulates for the theory of positive integers.'

E. V. Huntington: 'Second complete set of postulates for the theory of magnitudes or positive real quantities.'

W. B. Fite: 'On some properties of groups whose orders are powers of a prime.'

E. J. Wilczynski: 'On ruled surfaces whose flecnode curve intersects every generator in two coincident points.'

Virgil Snyder: 'Complete enumeration of sextic scrolls having a rectilinear directrix.'

F. Morley: 'On the triplicity of 3-points in a plane.'

C. L. E. Moore: 'Classification of surfaces of singularities in the quadratic spherical complex.'

L. D. Ames: 'On the theorem of analysis situs relating to the division of the plane or of space by a closed curve or surface.'

W. B. Ford: 'On the function defined by a Maclaurin series.'

P. F. Smith: 'Linear transformations of a quadratic form into itself.'

E. B. Wilson: 'Projective and metrical geometry.'

C. H. Sisam: 'On the depiction of the lines of a special linear complex on the points of space.'

Edward Kasner: 'Investigations on isothermal systems.'

About fifty persons attended the meeting. On Monday evening an informal dinner contributed to the pleasures of the occasion.

The next meeting of the society will be held at Columbia University on February 27. The Chicago Section will meet again in April and the San Francisco Section in May.

F. N. Cole,
*Secretary.*

## SCIENTIFIC BOOKS.

*The General Principles of Physical Science.* By Arthur A. Noyes. New York, Henry Holt & Co. 1902. Pp. vii + 172.

This is the first volume of a work on which the author is engaged, entitled the 'General Principles of Chemistry.' The present volume is introductory and has for its purpose the setting forth of the laws and general principles of physics and chemistry, so far at least as these underlie the broad subject which the author has undertaken.

The present treatment is altogether systematic and not historical, and is intended for readers and students who are making special study of what is now generally known as physical chemistry.

The book contains four chapters: I., 'The Object, the Methods, and the Sub-divisions of Science'; II., 'The Fundamental Con-

cepts of Physical Science'; III., 'The General Principles Relating to Matter,' and IV., 'The General Principles Relating to Energy.' To these are added a good general index.

The basal importance of the subjects with which these chapters have to do is well established and the author has achieved a signal success in the clear and comprehensive manner in which he has presented them to the reader.

For this is no rehash of what has been already well said by various authors on these subjects, but is clearly the result of a close personal inquiry into the underlying concepts of modern science. The reader is thus not infrequently asked to set aside the traditional form in which some concept has been hitherto expressed. The author's independence of thinking is well illustrated in his treatment of compounds and mixtures, kinetic and gravitational energy and the second law of thermodynamics.

Sometimes, however, an impression is left on the reader that the author's restatements of old laws are a little hasty and so lack the absolute singleness of idea or exact precision which should characterize any general statement in physical science.

Thus on page 117 we find Faraday's laws of electrolysis expressed as follows: '*The passage of electricity through an electrolyte is attended at each electrode by a chemical change involving a number of chemical equivalents strictly proportional to the quantity of electricity passed through, and dependent on that alone.*' This is hardly free from possible misunderstanding. A clearer statement of the facts, following the suggestion of the author, would be the following: The passage of electricity through any electrolyte is attended by chemical *changes* which involve the *same* number of chemical equivalents at each electrode, and which are directly proportional to the quantity of electricity passed through and dependent on that alone.

Similarly on page 37 the statement of the law of multiple proportion would be clearer if the words *the same* were replaced by the words *a given,* so that the law would read: 'When one element combines with another in several proportions to form different chemical compounds, the quantities of the one element which in the several compounds are combined with *a given* quantity of the other element, stand to one another in the ratio of small whole numbers.'

The chapter on energy is especially valuable. Throughout, the concept of energy is regarded as fundamental and the concept of force is made secondary. The treatment of the various forms of energy is such as to bring into prominence the factors of a particular form of energy—namely the *intensity* and *quantity* factors.

The first and second laws of thermodynamics or energetics, as our physical chemistry friends are pleased to call them, are presented and discussed with great distinctness.

Credit also should be given the author for his consistent use throughout the book of a particular and distinct symbol or letter to denote a particular and distinct physical quantity. This saves the beginner many pains. Beginners will owe him also much gratitude because he has made such free use of numerical examples to illustrate the applications of the various principles.

It is a pleasure to say that the present introductory volume is a positive addition to the literature of physical science and the students of physical chemistry, especially in America, will await with eagerness the appearance of the volumes which are to follow.

E. H. LOOMIS.

PRINCETON UNIVERSITY,
December, 1903.

## SCIENTIFIC JOURNALS AND ARTICLES.

THE December number of the *Bulletin of the American Mathematical Society* contains: Report of the Boston Colloquium of the American Mathematical Society, by F. N. Cole; 'Linear systems of curves upon algebraic surfaces,' by H. S. White; 'An expression of certain known functions as generalized hypergeometric functions,' by E. T. Whittaker; 'On the factoring of large numbers,' by F. N. Cole; 'Note on the $p$-discriminant of ordinary linear differential equations,' by Arnold Emch; 'Hydrodynamic action at a distance,' by E. B.

Wilson; Shorter Notices of Braunmühl's 'History of Trigonometry' and of the recent reprint of Carnot's 'Treatise on heat engines' (1824); Notes; New Publications.

The January number of the *Bulletin* contains: Report of the October meeting of the American Mathematical Society, by F. N. Cole; 'Two systems of subgroups of the quaternary abelian group in the general Galois field,' by L. E. Dickson; 'The determination of the constants in the problem of the brachistochrone,' by Oskar Bolza; 'On three types of surfaces of the third order regarded as double surfaces of translation,' by A. S. Gale; 'On the generation of finite from infinitesimal transformations—a correction,' by H. B. Newson; Review of Study's Geometry of dynames, by Virgil Snyder; Review of Weber and Wellstein's Encyklopädie der Elementar-Mathematik, by D. E. Smith; Shorter Notices of the mathematical papers of the late George Green, Agnes M. Clerke's problems in Astrophysics, Müller and Presler's Constructive geometry, and Schilling's Catalogue of mathematical models; Notes; New Publications.

## *SOCIETIES AND ACADEMIES.*

### THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

THE fourth regular meeting of the Society for Experimental Biology and Medicine was held in the demonstration room of the department of physiology of Columbia University, at the College of Physicians and Surgeons, on Wednesday evening, December 16. Dr. S. J. Meltzer presided.

Reports of original investigations were offered as follows:

*The Changes in the Viscosity of the Blood Produced by Various Experimental Procedures, with Demonstrations:** R. BURTON-OPITZ.

Dr. Burton-Opitz described and demonstrated the apparatus used in determining the viscosity of the blood. This demonstration was followed by a discussion of the changes in the molecular friction of the blood after intravenous injections of distilled water, saline, dextrose and alcoholic solutions. The effect of alcohol, when introduced into the stomach and small intestine, was also noted. Next were considered the changes following subcutaneous administration of curare and the differences in the viscosity of arterial and venous blood. $K$, the coefficient expressing the viscosity was determined before and after each experimental procedure, two or three determinations being made in each case.

It was found that, if distilled water, in quantities of from 5 to 50 c.c., is slowly allowed to flow into the facial vein, the viscosity of the blood is increased, but the increase is not considerable. The following experiment may serve as a sample. The normal coefficient $K$, in a dog weighing 19.2 kilos, was 802.6, or 5.8 times greater than $K$ for distilled water at 37° C. After the injection of 10 c.c. distilled water the coefficient showed the value 786.0, or 6.0 times greater than distilled water at 37° C. Normal saline solutions produce the reverse effect, *i. e.*, the blood becomes less viscous. In one case after injecting 10 c.c. of 0.7 per cent. NaCl solution, the viscosity of the blood fell from 5.9 to 5.6 times that of distilled water at 37° C. Concentrated solutions of dextrose (5 c.c.) injected into the facial vein bring about an increase in the viscosity of the blood which is more pronounced than that produced by distilled water. About half an hour after the injection the coefficient $K$ shows again its normal value.

If from 3 to 5 c.c. of 10 or 25 per cent. solutions of alcohol in water are allowed to flow into the facial vein, the molecular friction of the blood becomes greater. The same result can be obtained by introducing the alcohol directly into the stomach or duodenum. 30 c.c. of a 25 per cent. solution were injected into the stomach. The viscosity determined twenty minutes later showed the value 608.09, as against 664.17, the normal coefficient. Thus, instead of being only 7.0 times greater than that of distilled water at 37° C., it changed after the injection to 7.7 times greater. An equally decisive change occurred after injecting 40 c.c. of a 25 per cent. solution into the

* The abstracts here given have been prepared by the authors themselves. The secretary has made only a few abbreviations and minor changes.

duodenum. A marked increase in viscosity also follows subcutaneous administration of curare; however, this result is not evident until the respiratory muscles become paralyzed.

Venous blood is slightly more viscous than arterial, but the difference is often very insignificant.

In all these determinations a direct parallelism exists between the viscosity values and the specific gravity. When the viscosity increases the specific gravity increases also, and *vice versa*. Not a single exception to this rule could be found.

The viscosity was also determined in a dog having very large thyroid bodies. The right gland weighed 57, the left 52 grams. The viscosity coefficient, obtained by eight determinations, showed the value 1,233.17 (specific gravity 1,05028), which means that the blood of this animal was only 3.8 times more viscous than distilled water at 37° C. The lowest previous value obtained by Dr. Burton-Opitz occurred in a dog after three days of hunger. $K$ equaled in this case 1,110.3 (4.2 times more viscous).

In general it may be said that the less the viscosity the longer the period required for extra-vascular coagulation. This was especially well shown in the case just mentioned. Clotting set in after about fifteen minutes.

*Survival of an Animal after Removal of both Suprarenal Capsules, due to a Previous Grafting of the Organ into the Kidney:* S. J. MELTZER (for F. C. Busch and Charles van Bergen, of the Department of Physiology at the University of Buffalo).

Dr. Meltzer stated that in several instances survival of a part of suprarenal grafts was obtained after transplantation into the kidney of the same animal.

In one experiment the animal (a rabbit) survived, after apparently all other suprarenal tissue, aside from that which was grafted into the kidney, had been removed. In this case, after total removal of the left suprarenal a part of the gland, including medulla and cortex, was introduced through an incision into the cortex of the left kidney. Eighty-six days later the remaining right suprarenal was removed *in toto*. The animal survived the operation and was apparently normal for twenty-one days, at the end of which time it was killed in order to examine the graft. This was found, upon histologic examination, to have been in part replaced by connective tissue. The surviving cells apparently belong to the medullary portion of the suprarenal. The cortex had been replaced by connective tissue. Blood supply was good.

Slides showing the successful grafts were exhibited under the microscope. In this connection, also, Dr. Meltzer showed, under the microscope, a section of Zuckerkandel's organ, the chromophilic bodies of which are similar in nature to the chromophilic granules of the medullary portion of the suprarenal capsule.

*On the Absence of a Cane Sugar Inverting Enzyme in the Stomach:* GRAHAM LUSK.

It was shown by Professor Lusk that free hydrochloric acid and not an enzyme caused the inversion of cane sugar in the stomach.

*A new Head Holder for Rabbits, with Demonstration:* FREDERIC S. LEE.

The following reviews were made:

*The Action of Potassium Cyanide upon the Unfertilized Egg:* HOLMES C. JACKSON.

Loeb and Lewis were the first to note the fact that unfertilized eggs (of the sea urchin), when placed in $n/1,000$ KCN solution, retain their capability of fertilization much longer than when suspended in normal sea water. This was ascribed to the action of the KCN in inhibiting intracellular autolytic processes which lead normally to maturation and finally death. The bactericidal action of KCN was excluded, as the result of experiments in which eggs apparently died as rapidly in sterile as in putrid sea water.

Gorham and Tower's experiments in the same connection indicated, on the other hand, that the effect of KCN was entirely bactericidal. The sterile eggs retained their capacity for fertilization longer under absolutely sterile conditions than when placed in $n/1,000$ KCN.

As the question now stands there exist two almost identical series of sterilization experiments by two pairs of investigators, with results diametrically opposed to each other. Critically considered, the more carefully con-

ducted experiments seem to be those by Gorham and Tower; and in the lack of further evidence in favor of an intracellular action of KCN in this connection, we must conclude that the destruction of the bacteria by the KCN removes the condition which causes the death of the cell, and in the absence of which the eggs retain their potential power for growth after fertilization.

*Results of Recent Investigations in Proteid Chemistry:* P. A. Levene.

Recent work on the chemistry of the proteid molecule has furnished explanation of many biological phenomena. Thus, in certain pathological conditions there appears in the urine a sulphur and nitrogen-containing substance, cystin. The source of the substance in the organism had been unknown, until through the efforts of Mörner and Embden and others, its radical was demonstrated to be a normal constituent of the proteid molecule.

The chromatin of a developed cell differs from that of an unfertilized egg by the presence in it of radicals of purin bases. It is probable that these bases are derived from the histidin radical, which is also a normal constituent of proteids.

Hemoglobin is known to be absent from the unfertilized egg and it appears only in course of development of the embryo. It was shown recently that the non-proteid part of hemoglobin is a pyrrol derivative and it is probable that a pyrrol radical is present in the proteid molecule. Chlorophyl is also a pyrrol derivative, a fact further establishing its close relationship to hemoglobin.

The work of Emil Fischer points to the way in which the various component radicals may combine in order to form the proteid molecule, and makes probable the eventual synthesis of true proteid material.

*New Members.*—The gentlemen named below were elected to membership: A. C. Abbott, Isaac Adler, B. H. Buxton, J. McK. Cattell, H. L. Cushing, E. K. Dunham, Simon Flexner, Reid Hunt, Hugo Münsterberg, J. A. Murlin, Horst Oertel, E. L. Opie, Theobald Smith, A. B. Wadsworth, R. S. Woodworth, Naohidé Yatsu.

William J. Gies,
*Secretary.*

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

The section met on November 23, in conjunction with the American Ethnological Society. A paper was read by Dr. Clark Wissler, 'Recent Researches on the Decorative Art of the Plains Indians.'

It was demonstrated by specimens and explanations that among the Indians of the plains may be found a type of graphic art that is purely decorative in contrast to a type that is absolutely symbolic. In addition, a transition type occurs in which both the symbolic and the asthetic motives function. The whole of this art is the work of women. In the purely decorative art complex, geometric designs are built up from simple geometrical elements. These elementary designs have technical names and are worked into compositions according to recognized principles and standards. In the symbolic art the designs are conventional representations of objects with sacred or mystic associations and are realistic in motive. While a number of conventional designs are used which are known once to have possessed symbolic value and to have originated in realistic motives, the majority of design elements do not appear to have originated in this way. Their occasional use in a symbolic sense is an afterthought and a makeshift. From which it appears that the graphic art of these Indians, as we find it to-day, is an objective development in contrast to the subjective symbolism of other tribes.

James E. Lough,
*Secretary.*

SECTION OF GEOLOGY AND MINERALOGY.

The regular meeting of the section took place December 14, 1903, with Professor James F. Kemp in the chair.

The first paper on the program was 'Explorations and First Ascents in the Canadian Rockies,' by Professor Herschel C. Parker.

This paper occupied the evening. It consisted of an illustrated lecture describing the section of the Rocky Mountains in British Columbia and Alberta known as the 'Canadian Alps.'

In a brief introduction an explanation was

given of the physical characteristics that determine the alpine nature of mountain ranges, and it was pointed out that the Rocky Mountains of Canada may justly be termed the 'Switzerland of America.'

A series of more than 100 lantern slides was shown, many of them illustrating six first ascents made by the lecturer. These summits were: Mt. Dawson, the highest peak of the Selkirks; Mt. Goodsir, one of the highest and most difficult peaks in British Columbia; Mt. Lefroy, Mt. Hungable (the 'Chieftain'), Mt. Deltaform and Mt. Biddle, these latter peaks being situated in Alberta near Lake Louise. The summits of some of these mountains were previously thought to be practically inaccessible and the climbs were attended with the very greatest difficulties. Mt. Lefroy was climbed by the lecturer in 1897, Mt. Dawson in 1899 and the remaining four summits during the past season.

The lecturer also briefly described an interesting trip of about 100 miles north of the railroad to Wilcox Pass, where the Saskatchewan and Athabasca Rivers take their rise.

The following two papers were submitted for reading by title and subsequent publication:

*Gem Minerals of Southern California:* DR. GEORGE F. KUNZ.

In this paper the author said in part that California, especially in its southern portion, had of late years produced the most interesting gem minerals of any state in the union. First came the magnificent series of colored tourmalines, described in recent reports of the Division of Mining and Mineral Resources, U. S. Geological Survey (1899, p. 38; 1900, p. 33; 1901, p. 31); next, the remarkable rose-beryl from Mesa Grande and Pala (*ibid.*, 1900, p. 32), and lastly, the amethystine spodumene (kunzite), in crystals which for purity and beauty of color are unrivaled by any other mineral of North America.*

Thus far the minerals are confined to two counties. The tourmalines occur near San Jacinto, in Riverside County, and at Mesa Grande and Pala, in San Diego; the pink beryl, in small amounts, at the two last-named localities; and the lilac spodumene at Pala, and also to some extent at Coahuila, in Riverside County, in crystals of similar character but smaller. Other interesting gem minerals are now coming to light in association with the preceding ones. With the spodumenes from Coahuila have been found beautiful beryls, some yellow, closely resembling those from Sarapulka in the Ural Mountains, others pale green and even colorless. Some of the yellow crystals are finely formed, and the others show instances of remarkable etched faces, similar to the crystals from Sarapulka in Perm; while others are almost as delicate as a darning needle. The etching in certain of these is most curious; crystals of three inches long and an inch across, colorless and transparent as the finest rock crystal, are covered all over the prismatic and basal planes with the most complicated etching, and within are hollow, made up of interlocking plates, as it were, exceedingly clear and brilliant.

From Pala came a fine doubly terminated, detached pink beryl which measured 10 cm. by 5 cm., and which was quite transparent and an object of great beauty.

Another mineral recently observed at Coahuila is spessartite (manganese-aluminum garnet), in trapezohedral crystals of remarkable beauty. Some of these are absolutely pure and measure from 6 to 10 mm. in diameter, while large ones are as much as 30 mm., but less perfect. They are implanted upon crystals of albitic feldspar, recalling strongly the occurrence at Amelia Court House, Virginia. The smaller crystals are exceedingly brilliant and beautiful, of a honey-yellow color, deepening to orange-red; others are quite large, but not transparent. The crystalline form is that of the trapezohedron, *n*, in combination with the rhombic dodecahedron, *d*.

Lastly, and of great interest, is the first-noted occurrence in the state of topaz, in distinct and beautiful crystals. The source is the well-known mineral locality three miles from Ramona, in San Diego County. One crystal is absolutely transparent, of a pale blue color, like those from the Ural region, and measures 2 cm. by 1 cm. by 5 mm. The faces

* *Amer. Jour. Science*, Vol. 16, November, 1903; *N. Y. Acad. Sciences*, October 19, 1903.

$c$ and $X$ are entirely absent; those present are $p$, $d$, $o$, $f$ and $g$, with $m$ and $l$ of the prism; the pyramid faces are etched. The general character strongly recalls the Alabashka type of the Urals, and this likeness would suggest that the minerals to be found with it will also resemble those of that noted locality. Other crystals are perfectly colorless, but with the same general form and proportions; those of about one centimeter in length are extremely brilliant, the larger ones less so externally, but clear within. It is of great interest that this belt of rare species which traverses the state in its southern portion gives indication of further occurrences of remarkable minerals there to be found.

*Clackamas Meteoric Iron:* Dr. George F. Kunz.

There has lately been discovered in Oregon an enormous iron meteorite, ranking with the two immense ones found respectively by Lieutenant Peary in Greenland and by Professor H. A. Ward in Mexico. This is a mass of iron, measuring ten feet in length by seven in width and five in height, pitted in the usual manner, but in an extensive degree, and at one point even perforated, so as to leave an opening through it as large as a man's hand. It was discovered in the autumn of 1902 by a prospector, Mr. Dale, on land belonging to the Oregon Steel and Iron Company, some two miles south of Oregon City, in Clackamas County. The official statement of its location is T. 2, S.; R. 1, E. of Willamette Meridian. It was dug loose from the soil and removed on a truck to adjacent land belonging to Mr. Ellis Hughes, where it now lies, subject to a claim by the company and a suit now in progress. The material has been subjected to analysis by a local chemist and found to contain a small percentage of nickel; but the exact figures are not yet in the author's possession. According to Mr. A. W. Miller, of Portland, Oregon, from whom most of the facts have been learned, a piece which he examined for structure did not show the Widmanstatten figures, but a marked cubical structure, with very high silvery luster. A fine photograph sent by him to the author shows the mass as roughly conical or dome-shaped, on an elliptic base, wonderfully pitted, and with the hole through its lower portion. Men standing by it indicate its size, which is perhaps as large as that of any other meteorite known.

Edmund Otis Hovey,
*Secretary.*

## MICHIGAN ORNITHOLOGICAL CLUB.

The last meeting of the Michigan Ornithological Club for the current year was held at the Detroit Museum of Art on December 6. President Adolphe B. Covert presided. There was a good attendance and the papers presented were of much interest. The program was as follows:

Norman A. Wood: 'The Discovery of the Breeding Area of Kirtland's Warbler in Michigan.'

Alexander W. Blain, Jr.: 'Observations made on the Habits of Birds of the Family Mniotiltidæ in Monroe County, Michigan, by Jerome Trombley, during the years 1875–81.'

J. Claire Wood: 'Some Late Breeders.'

Edward Arnold: 'Nesting of the Sandhill Crane in Michigan.'

Professor A. H. Griffith: 'Birds in their Relation to Art.'

Following the papers a business session was held. Dr. J. A. Allen, of the American Museum of Natural History, Wm. Brewster, of Cambridge, and Robert Ridgway, of the Smithsonian Institution, were elected to honorary membership. Many new active members were elected. The constitution was amended so as to allow quarterly instead of monthly meetings. A class of patrons was created.

The next meeting of the club will be held at the Detroit Museum of Art on February 5, 1904. Visiting ornithologists are cordially invited to attend.

Alexander W. Blain, Jr.
Detroit College of Medicine.

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## *DISCUSSION AND CORRESPONDENCE.*

### THE WORD BAROMETER.

To the Editor of Science: In my letter of August 28 I expressed the belief that the letter of John Beale to Robert Boyle bearing date February 6, 1665, should read 1666. Since then Dr. J. B. Nichols, of Washington, D. C., has called my attention to the system of

double dating in vogue during the time that both church and civil almanacs were in use. During this time a date falling between January 1 and March 25 would by the church almanac be a year earlier than the same date on the civil almanac. This was sometimes indicated by a double date thus, February 6, 1665/6.

This was a point that I had overlooked, as had also Drs. Rotch and Bolton. A reexamination of the various dates and of their context leads to the following conclusions. John Beale's letter was written February 6, 1665/6. The paper cited by Dr. Rotch and myself is of date March 24, 1665/6. Henry Oldenburg's letter to Robert Boyle, cited by me, is of date March 19, 1665/6.

During the year 1665 several instances of the use of the word 'barometer' are to be found in Robert Boyle's correspondence. In Robert Boyle's paper of April 2, 1666, he refers to 'barometrical observations' made by John Beale; these observations Henry Oldenburg transmits to Robert Boyle on December 19, 1665 (Vol. V., p. 343), and again on December 30, 1665, and on January 16, 1665/6.

More interesting than the above is what would seem to be the original passage in which the word barometer is used. This passage I found by following up the reference in John Beale's letter to the three papers on 'thermometers and baroscopes.' A close examination of Robert Boyle's papers shows these to be three papers printed with the 'History of Cold' in the spring of 1664/5. They are entitled 'New Thermometrical Experiments,' and are preliminary to the 'History.' There is also an introductory note by Henry Oldenburg of date March 10, 1664/5, and beginning thus: 'I am fully persuaded, you will much rejoice to see that exquisite searcher of nature, the illustrious *Robert Boyle*, come abroad again, * * *' (Vol. II., p. 231). A little further on he says: "I am now to advertise you of one or two circumstances necessary to be taken notice of in its perusal. One is that the noble author being at Oxford, when the book was printed at London, he hopes the reader will not impute to him the errors of the press, which yet he is persuaded will not be many, and out of which must be excepted a blank or two, occasioned by this, that the author's papers being near two years since given to be transcribed to one. * * *" This passage shows that the papers were written by Robert Boyle prior to March, 1662/3.

Turning to the author's preface we find the following, "* * * how great a power my friends have with me * * * the reader may guess by the preamble he will find prefixed to the first title of the ensuing history. For by the date of that he will see how early my papers about cold were to have been communicated." The preamble bears date 'Little Chelsea, February 14, 1662, S. A.,' or 1663 civil almanac.

Turning to discourse I., we find the following interesting passage: "Among the several notes I find among my loose papers and in a diary I kept for a while of these observations, I shall content myself to transcribe the following two. * * * The first of these memorandums runs thus. Last night I took notice that there was but one or two divisions difference betwixt the two thermometers, but upon such a change of weather, that happened this day, as made me imagine that the atmosphere would be lighter than before, consulting the barometer (if to avoid circumlocutions, I may so call the whole instrument wherein a mercurial cylinder of 29 or 30 inches is kept suspended after the manner of the Torricellian experiment) * * *" (Vol. II., p. 244b). The date of the diary from which these remarks are taken is not given, and the best that can be concluded from a reading of the whole paper is to say that the date must be prior to March, 1662/3, and probably prior to February 14, 1662/3. Later on in the same paper the word baroscope is used.

It is a pity that Robert Boyle had not earlier followed the determination of giving all requisite dates, expressed by him in the following letter to Henry Oldenburg, dated October 26, 1667. "* * * Care will be taken for the future, that the letters I send you be dated. * * * And I am the more solicitous about this matter, because frequent experience shews us how much our English have lost, for want of being so; and (which is more

considerable) how difficult it is, otherwise, to avoid the occasions of personal disputes, or reflections; which, for my part, I heartily desire to shun" (Vol. V., p. 252b).

One can not but conclude, judging from the phraseology, that the passage in the *Phil. Trans.* cited by Dr. Bolton is from the same pen as Henry Oldenburg's prefatory note. Further evidence of the same authorship is found in the capitalization, following, as it does, the German method. Now Robert Boyle would not be likely to use this mode of writing, while Henry Oldenburg, being a native of Bremen in lower Saxony, might easily have lapsed into the style of his native tongue.

John C. Shedd.
Physical Laboratory,
Colorado College.

## SPECIAL ARTICLES.

### COLOR INHERITANCE IN MICE.

Within the last few years great interest has been aroused by the rediscovery of Mendel's Law of Dichotomy in plant hybridization. This law has been confirmed for many species of plants, especially by De Vries (1902, pp. 146–151, etc.), Correns, Tschermak and others. The study of mice, rats and rabbits has yielded a partial confirmation of this law for animals. I wish here to contribute additional although too meager data drawn from my experiments of the past four years.

The two great laws enunciated by Mendel were these: Of the two antagonistic peculiarities possessed by two races that are crossed, the hybrid, or mongrel, exhibits only one; and it exhibits it completely, so that the mongrel is not distinguishable as regards this character from one of the parents. Intermediate conditions do not occur. That one of the two parental qualities that alone appears in the mongrels is called dominant; the other recessive. Second, in the formation of the pollen or egg-cell the two antagonistic peculiarities are segregated; so that each ripe germ cell carries either one or the other of these peculiarities, but not both. It is a result of the second law that in the second generation of mongrels each of the two qualities of their grandparents shall crop out on distinct individuals, and that the recessive quality shall appear in 25 per cent. of the individuals, the remaining 75 per cent. having the dominant quality. Such recessive individuals, crossed *inter se,* should never produce anything but recessive offspring.

Now experiments with animals have revealed the existence of recessive qualities—*e. g.,* in mice, when white and wild gray are crossed and the mongrel offspring are crossed *inter se,* the second mongrel generation will yield some white mice, and such white mice, bred *inter se,* will thenceforth produce only white mice. These results have been got by Crampe (1885), von Guaita (1898, 1900)—cf. Davenport (1900)—Cuénot (1902, 1903)—cf. Bateson (1902, p. 173)—Darbishire (1902, 1903), Castle (1903) and Bateson (1903). Is the percentage of the recessive individuals always 25? In such a second mongrel generation Cuénot (1902) found 162 gray and 57 albino individuals, or 74 per cent. to 26 per cent., and in von Guaita's breedings between walzing and albino mice the crossed gray hybrids gave 25 per cent. albinos; results that accord with theory. But instead of the 75 per cent. gray which Mendel's law calls for, von Guaita got 57 per cent. gray and 18 per cent. walzing mice of gray, gray-white, black, and black and white colors. Rabbits gave Woods (1903) only 21 per cent. instead of 25 per cent. of the recessive type in the second mongrel generation, and in crossing hybrids with albinos he got only 40 per cent. albinos instead of 50 per cent., as theory demands.

The discussion concerning the validity of Mendelism for mice has been based chiefly upon crosses between albinic mice on the one hand (Crampe, Cuénot, Castle and Allen) and gray or walzing mice on the other (Haacke, von Guaita, Darbishire). Bateson (1903) alone has recorded, without details, the results of crossing mice of varied colors. His data will be referred to in the following account of my experiments.

#### A. THE OFFSPRING OF MICE OF THE SAME COLOR.

I. *Albino* $\times$ *Albino.*—This cross appears to produce only albinos. Bateson (1903, p. 76) has examined the evidence and finds only one

doubtful case where white mice produced colored offspring. In two crosses of white parents I got nine offspring; all were white.

II. *Yellow* × *Yellow*.—1. Yellow-red (8)* × yellow-red (7). The mother (8) was yellow-red with a patch of white below; the father was pure yellow-red. Of the offspring one was pure yellow-red like the father, two were brownish yellow above and much lighter below, one was brownish red with patches of white, and five were chocolate with yellow flanks and patches of white above and below. Thus, one bred true to the father but the remainder were much darker and had a mixture of colors.

2. Muddy yellow $\left(35\begin{cases}\text{white (6)}\\ \text{yellow (7)}\end{cases}\right)$ × yellow (7). Of the four offspring one was a uniform light yellow (57); one was yellow above and white below and on the flanks (59); one was dirty yellow above, white below (58); and the last was wild-mouse gray (or agouti) above and white on belly and flanks. The result in both cases is seen to be very variable.

III. *Black* (*2*) *and Black* (*2*).—My blacks seemed delicate and relatively infertile, so that of two crosses only two individuals survived—both were black. Black behaves something like albinism. Is it not likewise recessive?

IV. *Chocolate* × *Chocolate*.—Chocolate is a broad class including various shades of color from a dark red-gray to a dark red-yellow. I raised four families as follows: 1 and 2. Chocolate (10) × Chocolate (1) with nine offspring, as follows: Uniform chocolate, nos. 22, 23, 26, 66 and 65. Chocolate above, more or less white below, nos. 67, 68. Chocolate with white spots, nos. 24, 25.

3. Chocolate $\left(66\begin{cases}10\\1\end{cases}\right)$ × Chocolate $\left(25\begin{cases}10\\1\end{cases}\right)$.

These full siblings† of chocolate parents produced five offspring. All were of a uniform chocolate color.

4. Chocolate $\left(67\begin{cases}10\\1\end{cases}\right)$ × Chocolate $\left(25\begin{cases}10\\1\end{cases}\right)$.

* The numbers in parentheses are those of the pedigree mice.

† Sibling (Pearson) is a term applicable either to brother or to sister.

There was only one survivor of this pair; it was chocolate colored excepting for some white on the belly.

Thus the chocolate color shows itself rather stable, especially in the second pure bred generation.

B. THE OFFSPRING OF MICE OF DIFFERENT COLOR.

I. *Gray and White*.—This cross has been made by several investigators, as indicated above. The usual result is that the offspring in the first filial (mongrel) generation ($F_1$ in Bateson's nomenclature) are prevailingly gray like the wild house mouse. My own experience is partly confirmatory.

A wild house mouse (15) × albino (5) gave five offspring: nos. 47 to 51. Four of these resembled the wild mother in coat excepting that they were yellower on the back of the neck and of a cream color in the region between the fore legs and also between the hind legs. Also the coat had a richer, glossier look than the mother's. The other one of the offspring was generally agouti above and ashy below, but the hairs of the ventral part of the shoulder girdle were yellow tipped, there was a mid-ventral white patch and there were five distinct white patches on the dorsal side. These were unlike anything in the mother, and indicated particulate inheritance by the mongrel from both parents, but especially from the mother. My results agree with those of Crampe, who found that similarly bred rats give in $F_1$ either uniformly gray or gray and white. Darbishire (1903) crossing walzers and albinos finds that the mongrels have the less white the purer bred the albinos are, and von Guaita's pure-bred albinos gave all gray offspring when crossed with walzers. I know nothing of the ancestry of the albino (5); but it may be inferred that it was not pure bred. With an albino that had been bred pure for two generations I got the following result:

$$\text{Gray}\left(54\begin{cases}\text{21, chocolate } (10\times 1)\\ \text{29, house}\end{cases}\right) \times \text{white}\left(18\begin{cases}\text{4, white}\\ \text{5, white}\end{cases}\right).$$

Five offspring were obtained all gray like a

house mouse, but of a lighter color. Probably the earlier crosses of Crampe (1877, p. 390, 391) with white and gray rats that led him to the conclusion that in inheritance the color of the species shuts out the color of the variety were made with pure bred rats. Cuénot crossing grays and albinos got gray mice without exception in the $F_1$ generation.

From the foregoing the conclusion may be drawn that the offspring of pure-bred gray mice crossed with albinos inherit chiefly from the wild form but that the color is slightly modified, particularly when the albinos are not pure bred, first by an increase in the yellow and, secondly, in some cases, by the presence of white. Gray is dominant over albinism but the soma derived from hybrid germ cells shows traces of the albinic blood. The dominance is incomplete. The dominance, so far as it goes, accords with De Vries's (1902, p. 145) generalization that the older type or the wild species is dominant over a more recent type or a cultivated variety.

When these gray mice are crossed *inter se* there result gray mice and white mice in the proportion of three to one (Cuénot; Castle and Allen, 1903), and the albinos show themselves purely recessive. That all recessive mice are, however, not alike, but differ according to their ancestry has been argued by Darbishire from the fact that pure bred albinos transmit less to $F_1$ than albinos do that are derived from a mixed ancestry.

II. *Wild Gray (45)* $\times$ *Black (9)*.—Two offspring of this cross were essentially of the wild, maternal color.

III. *Wild Gray (29♂)* $\times$ *Chocolate* $\left(21 \begin{cases} 10 \\ 1 \end{cases}\right)$.

—Nos. 52 and 54 were marked like the wild gray but were darker. No. 53 had a dark back, a light yellow belly and white on the shoulders and in the middle of the right flank. No. 55 had a back like the house mouse, but its shoulders were white and its belly yellow and white. In these offspring there was an attempt at least at blending and there was a cropping out of an ancestral white, but on the whole the gray dominated.

IV. *Black* $\times$ *Albino*.—This cross was made twice.

$$1.\ \text{Black} \left(19 \begin{cases} 2,\ \text{black} \\ 9,\ \text{black} \end{cases}\right) \times \text{albino} \left(18 \begin{cases} 4,\ \text{albino} \\ 5,\ \text{albino} \end{cases}\right).$$

Five young were obtained, all reversions, being of typical wild mouse color except that two of them had white spots on the belly.

2. Black (126) $\times$ Albino

$$\left[\,102 \begin{cases} 57,\ \text{reversion} \begin{cases} 35,\ \text{yellow (6, albino} \times \\ \quad 7,\ \text{yellow)} \\ 7,\ \text{yellow} \end{cases} \\ 18,\ \text{albino} \begin{cases} 4,\ \text{albino.} \\ 5,\ \text{albino} \end{cases} \end{cases}\right.$$

—The two offspring were reversions, but one had a white spot at the center of the belly. These two matings indicate that neither black nor white is dominant, but that the repressed ancestral gray character is, as it were, liberated.

V. *Black (137)* $\times$ *Yellow*

$$\left[\,136 \begin{cases} 102,\ \text{albino} \\ 130,\ \text{reversion} \begin{cases} 102,\ \text{albino} \\ 126,\ \text{black} \end{cases} \end{cases}\right].$$

—The single offspring was a typical reversion except that the front part of the belly and the flanks were white. Bateson (1903, p. 85) states that Miss Durham got sables and dingy fawns and even blacks from this cross. In any case there is no evident dominance.

The following cases are still more complex.

$$\text{VI. } \textit{Reversion} \left(32 \begin{cases} 6,\ \text{white} \\ 7,\ \text{yellow} \end{cases}\right) \times \textit{Gray} \left(47 \begin{cases} 15,\ \text{wild} \\ 5,\ \text{white} \end{cases}\right).$$

—There were two of the progeny of this pair that survived infancy—both were of the typical wild mouse color.

$$\text{VII. } \textit{Reversion} \left[\,109 \begin{cases} 57,\ \text{gray} \begin{cases} 35,\ \text{yellow} \\ 7,\ \text{yellow} \end{cases} \\ 18,\ \text{white} \begin{cases} 4,\ \text{white} \\ 5,\ \text{white} \end{cases} \end{cases}\right]$$

$$\times\ \textit{Reversion}\left[117\left\{\begin{array}{l}77,\ \text{yellow}\left\{\begin{array}{l}34,\ \text{yellow}\\42,\ \text{yellow}\end{array}\right.\\48,\ \text{gray}\left\{\begin{array}{l}15,\ \text{wild}\\5,\ \text{white}\end{array}\right.\end{array}\right.\right].$$

—There were three offspring; one was uniformly black (a color not found in the ancestry for at least three generations) and two were white. Black rats were got by Crampe (1877, p. 394) by crossing mongrels between wild and white-and-black rats; and black mice by von Guaita by crossing piebald dancing mice with albinos.

$$\text{VIII. }\textit{Piebald}\left(34\left\{\begin{array}{l}6,\ \text{white}\\7,\ \text{yellow}\end{array}\right.\right)$$

$$\times\ \textit{Gray-yellow}\left(42\left\{\begin{array}{l}8,\ \text{yellow}\\7,\ \text{yellow}\end{array}\right.\right).$$

—Of the six offspring four (nos. 77, 78, 79, 81) had the back colored yellow-red. In matching the color with the color wheel red, orange and yellow were found to constitute 60 per cent. to 70 per cent. of the color. In no. 82 the dorsal pelage was yellow-chocolate, with the color formula, N51, R28, Y12, W9;* and in no. 80 it was chocolate, with the color formula, N76, R13, Y4, W7. Four had some white on the belly or flanks. In this cross a new color—chocolate—arose, which I interpret to mean that some of the primitive gray was added to the yellow; that is, there was a partial reversion. Otherwise the yellow is dominant.

IX. *Gray and White*

$$\left(57\left\{\begin{array}{l}37,\ \text{yellow (6, white}\times\text{7, yellow)}\\7,\ \text{yellow}\end{array}\right.\right)$$

$$\times\ \textit{White}\left(18\left\{\begin{array}{l}4,\ \text{white}\\5,\ \text{white}\end{array}\right.\right).$$

—There were eight offspring, three albinos and five gray. Four of the latter had white patches on the sides, legs or middle of the belly. This is like the case described by Castle (1903, p. 542).

### C. SUMMARY OF RESULTS.

When the parents are of the same color, especially if they are pure bred, there is a strong tendency for the offspring to be of the same color as the parents. In the case of albinos this tendency is so strong that the offspring are probably always albinic; if both parents are black the tendency to black offspring is likewise very strong; if chocolate, the result is more variable; if yellow, still more intermediate. The results indicate that there are different degrees in the strength of inheritance of different colors.

When the parents are of dissimilar color the offspring show different kinds of inheritance in the different cases. When gray and white are crossed the offspring are gray with a little white, and this white is the more reduced the purer bred the albinic parent; the gray is dominant. Likewise in the cross of gray and black, black is quite shut out, and the same is true of gray and piebald rats (Crampe, 1877, p. 394). The wild, gray color is strongly prepotent. Melanism and albinism act quite similarly in crossing. Both are in the nature of 'sports.' Perhaps 'purity of the germ cells' is the mechanism of isolation for which we have been so long looking, by which mutations are preserved from the 'swamping effects of intercrossing.'*

When gray and chocolate are crossed the gray is incompletely dominant. When black and white are crossed, typical reversions appear; neither color is dominant. When black is crossed with yellow the result is highly variable. If white and yellow be mixed in various proportions for several generations the progeny takes on various shades of yellow and may acquire the wholly new color of chocolate. Similarly, black may result from a mixed ancestry in which there is no black. The study of the cropping out of new colors certainly forms an enticing subject for further inquiry.

### D. BEARING OF THE RESULTS ON MENDEL'S LAW.

The enthusiasm kindled by the discovery of a new law leads us to go to extremes, to as-

* N, nigrum, black; R, red; Y, yellow; W, white. The numbers are percentages.

* Since the above was written I have received Castle's paper in SCIENCE for December 11, 1903, in which he states that the long-haired character in the Angora guinea-pig is recessive. This character is probably a mutation, and as such behaves in accordance with the above hypothesis.

sume its universal validity, and to overlook apparent exceptions. Those who insist upon a critical examination of all evidence against as well as for the theory run the risk of being regarded as lukewarm and as clogs on the wheels of progress; but they should not be deterred on that account from a full examination of all the facts in the interest of truth.

Mendel's Law is an hypothesis of great value both because it fits so many cases of inheritance and because it is stimulating to experimental investigations which will determine the limits within which it is valid.

The first limitation of Mendel's Law is stated by De Vries (1902, p. 141), who certainly can not be accused of lukewarmness toward the theory, since he was its rediscoverer. He says in effect: Mendel's Law of dichotomy holds in general only for phylogenetically recent characters, the so-called racial characters; and for only a part of those—what part we do not know. Even Mendel recognized that his rule was not generally applicable.

The second limitation of Mendelism concerns his theory of dominance. Sometimes when dissimilar racial characters are crossed one of them is dominant, and sometimes not. For example, gray is (within limits) dominant over white or black in mice, but when black and white or black and yellow are crossed there is no dominance of one color over the other; both are recessive and a reversion to the primitive gray occurs. The whole hypothesis of the purity of the germ cells will bear careful scrutiny. The best example of a recessive character in animals is albinism, but even in this case, as Darbishire has pointed out, the recessives can not be perfectly pure and independent of ancestry, for the mongrel mice coming from a recessive crossed with a gray differ according to the ancestry of the recessive. The result of this study is, I think, to add evidence that Mendel did not discover all the important laws of inheritance, and that further investigation will unquestionably reveal other and still broader principles of heredity.

C. B. Davenport.

Hull Zoological Laboratory,
University of Chicago,
December 13, 1903.

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## CURRENT NOTES ON METEOROLOGY.

### METEOROLOGICAL BIBLIOGRAPHY.

To the 'Note on Meteorological Bibliographies,' published in SCIENCE for December 18, p. 795, there should have been added a reference to one other publication which contains a valuable list of titles in physics and meteorology. This is the *Fortschritte der Physik, Halbmonatliches Litteraturverzeichniss,* an octavo publication, issued twice a month, now in its second year. The *Fortschritte der Physik,* already well known in this country, contains reviews of publications in astrophysics, meteorology and geophysics, but the *Fortschritte* necessarily appears some time after the date of the books and articles reviewed therein. The object of the new *Halbmonatliches Litteraturverzeichniss* is to publish the titles of all physical books and articles immediately after their issue, and without reference to the later reviews in the larger volumes of the *Fortschritte*. The matter is in the hands of the Deutsche Physikalische Gesellschaft, the editor for 'Cosmical Physics' being the well-known meteorologist, Dr. Assmann. No one can fail to appreciate the advantage of this bibliography, which appears frequently, is well edited, and will prove of the greatest service to meteorologists. It is altogether the best current meteorological bibliography published, although one could wish that an author catalogue were included, and that the same classification of subjects were used as in the 'International Catalogue' (or a better one). The price of the *Litteraturverzeichniss* is four Marks yearly.

### CLOUD OBSERVATIONS IN INDIA.

OBSERVATIONS of the movements of the upper clouds were made at six stations in India during the period 1895–1900, and the results are now discussed by Sir John Eliot in Vol. XV., Pt. I., of the Indian Meteorological Memoirs (pp. 112, Pls. XII., Calcutta, 1903). Nephoscopes of the Finemann pattern were used. No observations of altitude are included. The discussion concerns the directions of movement of each cloud type at each station, during dry and wet seasons. These being the first considerable Indian contributions to the study of the upper air movements as shown by cloud directions, the results are especially noteworthy. The movement of cirrus and cirro-stratus clouds is remarkably steady at the four northern stations (Simla, Lahore, Jaipur and Allahabad) during the dry season, being from almost due west, *i. e.,* in accordance with theory. The number of observations at Vizagapatam and Madras is small, but the indications are that the upper air movement recurves from southeast through south to southwest in the southern portions of India, also in general accordance with theory. The lower as well as the upper air movement is from west over the whole of northern and central India during the dry season, the direction of movement of the alto-cumulus, cumulus and cumulo-nimbus being almost as regular as that of the upper clouds, but more southerly. During the rainy season there is great variability and unsteadiness in the cloud movement up to the elevation of the highest cirrus at Allahabad, which is in the center of the Indian trough of low pressure at that season. Photogrammetric observations at Allahabad in 1898–1900 showed that the mean altitude of the cirrus in the rainy season is 32,654 feet. Hence it appears that the unsteady movement in the monsoon trough extends up to 30,000 feet at least, and perhaps even to 40,000 feet. The regular movement in the higher atmosphere (from west to east) is then suspended, or else occurs at a greater elevation than in the dry season.

### AIR PRESSURES IN INDIA.

VOL. XVI., Pt. I., of the 'Indian Meteorological Memoirs' contains the 'Normals of the Air Pressure Reduced to 32° F. and Constant Gravity, Lat. 45,' by Sir John Eliot. The memoir includes the monthly and annual means of the barometric observations at all observatories in India which have been in operation at least twenty years. At most of the observatories, the observations date from 1875, when the department was 'imperialized.' In June, 1878, the government of India sanctioned arrangements for the publication of a daily weather report, which included observations made at 10 A.M., at about 100 stations.

The hour was later changed to 8 A.M. It is to be noted that certain persistent discrepancies appear when the observations, after reduction to sea-level, are compared, the most noteworthy cases being those of stations which are more or less completely shut in by hills of considerable elevation. The result of this condition is to check somewhat the horizontal movement of the air, and to give too high a pressure during the morning. At the three stations where this topographic effect is most marked the excess of pressure averages about .02 inch at 8 A.M.

NOTE.

It is well known that the winter snowfall is a great help in lumbering operations in our northern forests, for it greatly facilitates the labor of hauling out the trees. In a recent article on the 'Forest School at Biltmore' (*Forestry and Irrigation,* November), Dr. Schenck notes, among the disadvantages of the Biltmore forest tracts, the lack of winter snows, which allow 'cheap sleighing to take the place of expensive wagoning.'

R. DeC. Ward.

## *THE ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS.*

The twentieth annual meeting of the association was held at the Columbian University, Washington, D. C., on November 19, 20, 21, with an attendance of 150, the largest on record. A large part of the meeting was devoted to the reports of the referees and associate referees on the analysis of foods. Dr. William Frear, as chairman of the committee on pure food standards, reported that those on meats and the principal meat products, milk and its products, sugars and related substances, condiments (except vinegar), and cocoa products, were ready for adoption as official and the proclamation so declaring them was signed by Secretary Wilson on November 21. The circular containing these standards is now in press and will be ready for distribution in a short time.

Slight changes were made in the official methods for the analysis of sugars and insecticides and a new division of the work was created by a motion to appoint a referee on drugs. A resolution was adopted requesting the Bureau of Standards through its chemist to participate in the work of the referees fixing standard methods of analysis. The committee on fertilizer legislation was instructed to prepare a bill for submission to Congress regulating interstate commerce in fertilizers and fertilizing materials.

The executive committee was given permission to call the meeting of the association next year at St. Louis and there is every probability that such action will be taken. The officers elected are as follows:

*President*—M. E. Jaffa, Berkeley, Cal.
*Vice-President*—C. L. Penny, Newark, Del.
*Secretary*—H. W. Wiley, Washington, D. C.
*Additional Members of the Executive Committee*—W. P. Headden, Fort Collins, Colo.; W. R. Perkins, Agricultural College, Mass.

## *SCIENTIFIC NOTES AND NEWS.*

Mr. Shyamaji Krishnavarma, of India, has offered $5,000 to Oxford University to establish a lectureship in honor of Herbert Spencer to be known as the Spencer Lectureship.

The prize for French contributions to science given by M. Osiris through the Paris Press Association has been divided between Mme. Curie and M. Branly. Mme. Curie receives 60,000 francs for her work on radium and M. Branly 40,000 francs for his work in connection with wireless telegraphy.

The sixtieth birthday of Dr. Robert Koch was celebrated on December 11. A portrait bust was unveiled in the Institute for Infectious Diseases, Berlin, a museum for bacteriology was established and a *Festschrift* is in press. Dr. Koch expects to return from South Africa in March.

At the St. Louis meeting of the Astronomical and Astrophysical Society of America the following officers, including those who hold over, were elected for the ensuing year: *President,* Simon Newcomb; *First Vice-President,* George E. Hale; *Second Vice-President,* W. W. Campbell; *Secretary,* George C. Comstock; *Treasurer,* C. L. Doolittle; *Councilors,* Ormond Stone, W. S. Eichelberger, E. C. Pickering, R. S. Woodward.

At the St. Louis meeting of the Geological Society of America, Professor John C. Branner, of Stanford University, was elected president and Professor H. L. Fairchild, of the University of Rochester, was reelected secretary. We regret that the names were accidentally interchanged in the last issue of Science.

Governor Bates, of Massachusetts, in his annual message recommends the appointment of a state forester and greater attention to the forest resources of the state.

Professor N. S. Shaler, of Harvard University, will spend the next four months abroad traveling in Egypt, Asia Minor and Greece.

Dr. J. C. Branner, professor of geology at Stanford University, has received leave of absence and is about to go to Europe.

*The American Geologist* states that Mr. O. H. Hershey has charge of the gold mine in Humboldt County, California, and is studying the geology of the Klamath Mountains.

An Ohio State Forestry Association has been organized with Mr. W. I. Chamberlain as president, and Professor W. R. Lazenby as secretary.

Dr. Herman M. Biggs, medical officer of the health board of the City of New York, lectured at the College of the City of New York, on January 5, his subject being 'The Health of the City of New York.'

Sir Oliver Lodge lectured at the University of Birmingham on 'Radium and its Meaning,' on January 5, Mr. Joseph Chamberlain, the chancellor of the university, presiding.

Mr. Gifford Pinchot, chief of the Bureau of Forestry, will attend the meetings of the National Live Stock Association and the National Woolgrowers' Association, which will be held at Portland, Ore., from January 11–15, in order to learn the sentiment of these associations in regard to the policy of forest reserves.

Professor Russell H. Chittenden, director of the Sheffield Scientific School of Yale University, has announced the thirty-eighth Course of Sheffield Lectures for 1904. The list of subjects and speakers is as follows:

January 15. 'The Tower of Pelée: New Researches in Martinique': Professor Angelo Heilprin.

January 22. 'Triumphs of Engineering': Mr. Frank W. Skinner, C.E.

January 29. 'Expeditions among the Rockies of British Columbia; a Reconnaissance for the Platinum Metals': Mr. Howard W. DuBois, M.E.

February 5. 'Around the World in Search of the Unexpected': Mr. Horace Fletcher.

February 12. 'Recent Archeological Discoveries in Northwestern America': Mr. Harlan I. Smith.

February 19. 'Wireless Telegraphy': Professor M. I. Pupin.

February 26. 'Comets': Professor Frederick L. Chase.

March 4. 'The Revolutionary Movement in the Philippines': Capt. John R. M. Taylor, U.S.A.

March 11. 'Electrochemistry at Niagara Falls': Professor C. F. Chandler.

March 18. 'Radio-activity': Professor Ernest Rutherford.

Professor Karl Alfred von Zittel, the eminent paleontologist of the University of Munich, died on January 6.

Mr. Henry W. Lothrop, a student of entomology, died at Providence, R. I., on January 5, at the age of sixty years.

Mr. Beverly Burton, an American chemist, who has resided in Munich for a number of years, died in that city on January 5.

A civil service examination will be held on February 3 and 4 to fill vacancies in the position of civil engineer in the Philippine services at salaries of $1,400 and $1,800.

The House of Representatives has appropriated $250,000 toward the eradication of the cotton boll weevil.

The will of Peter B. Brigham, of Boston, leaving $5,000,000 to the Brigham Hospital, has been sustained by the court.

John William Cudworth has bequeathed about £70,000 to the Dr. Pusey Library, Oxford.

Herr A. Samson has bequeathed to the Munich Academy of Science 500,000 Marks for research in scientific ethics.

The *Electrical World* states that in order to celebrate the twenty-fifth anniversary of the introduction and commercial development of

the incandescent lamp, the friends and associates of Mr. Thomas A. Edison have taken steps to found a medal which will be entrusted to the American Institute of Electrical Engineers. The circular which is being issued by the Edison Medal Asociation announces that it is the intention that the medals shall be awarded each year to the graduating student who shall present the best thesis on some original subject from the universities and colleges of the United States and Canada which have regular courses in electrical engineering. It is proposed that the medal shall be executed by some artist of distinction and that if possible a permanent fund of about $5,000 shall be established for its maintenance. It is proposed to present the medal fund at the annual dinner of the institute on February 11, which is Mr. Edison's birthday.

We learn from *Nature* that the Venetian Academy of Sciences, Letters and Arts, offers prizes of 3,000 lire under the Querini-Stampaglia foundation for monographs on the following subjects: The lakes of Venetian district, treated from a physiographic and biological standpoint; the works of Manuzi as a critic of Greek and Latin literature; the origins of Venetian painting; and advances in the projective geometry of algebraic surfaces of two dimensions in space of $n$ dimensions. Under the Cavalli foundation, a similar prize is offered for an essay on the effects of modern social and economic conditions, etc., on landlords and farmers, with especial reference to the Venetian provinces. Under the Balbi Valier foundation an award of the same amount is offered for advances in medicine or surgery for the period 1902–3, and under the Minich foundation a prize of 3,000 lire is offered for embryological researches on the development of the larynx, the trachea and the lungs in vertebrates and birds.

In his annual message Governor Odell, of New York, writes as follows in regard to the New York State School of Forestry: "By Chapter 122 of the Laws of 1898 the State purchased Townships 23 and 26 in the County of Franklin, and Cornell University thereupon took title and undertook practical demonstration and instruction in the School of Forestry. Its operations had for their object the substitution for so-called worthless timber of valuable growths, but this has resulted in the practical destruction of all trees upon the lands where the experiment was in progress. No compensating benefits seem possible to the present generation. The preservation of the forests is primarily for the protection of the water supply, and this is not possible through the denudation of the lands. Therefore this school failed of its object, as understood by its founders, a failure which was not due, however, to the work of the university, which followed out the letter and spirit of the law. The report of the committee of the assembly at the last session of the legislature, and the knowledge of the disapproval of many of our citizens, led me to veto the item for its support in the appropriation bill of 1903. The question, therefore, is before you, and to the legislature we must accordingly look for such action as will properly protect all interests. Cornell University undertook this work at the request of the state, and as such was its agent. In so doing it has made contracts for which it is primarily responsible, but which responsibility as the agent of the commonwealth it should not be called upon to assume. Neither should the school it founded be discontinued, because with the lapse of years a proper understanding of scientific forestry will become more and more a necessity. This is particularly true of farm forestry, which will form an important part in the future of agriculture within the state. That our people do not desire, however, that public lands shall be denuded is beyond question. It would seem, therefore, desirable that immediate legislation be had to recover to the state this property, of which there are about 30,000 acres, and for the payment into the treasury of the unexpended portion of the captital fund advanced by the state. Permission should be given to clear up and remove all cut timber and wood by the university, so that the danger of fire may be lessened. The contracts made between Cornell and the Brooklyn Cooperage Company might be left with the executive for adjustment, and failing in this either to the Court of Claims, if the state

is to be the party defendant, or to the Supreme Court if Cornell should be the responsible defendant. In neither case, however, should any burden be placed upon the university.

MR. JAMES BOYLE, U. S. Consul at Liverpool, England, writes to the Department of State that the British government has taken the first step toward the adoption of the decimal system of weights. It has just been announced by the Board of Trade that, under a special order in council, it will sanction the use of a weight of 50 pounds, instead of the present standards of 112 pounds (called a hundredweight) and 56 pounds (called a half hundredweight). The 50 pounds is by this action made a legal standard of weight. This reform has been adopted after forty years of agitation by Liverpool merchants and later on by petitions to the government by the chambers of commerce throughout the country, and particularly by the chamber of commerce of this city. Liverpool has felt the necessity for the change more than any other city, as this is the leading entrepôt for American and colonial produce of bulk, the weighing of which is a considerable item in the handling and, indeed, in the ultimate cost of the shipments. More cotton, corn, provisions and tobacco are imported into Liverpool than into any other city in the world, and by far the largest proportion of these imports come from the United States; so the United States is peculiarly interested in the reform just instituted. The Liverpool *Journal of Commerce* comments approvingly as follows:

All these great quantities are calculated by the American sellers in pounds avoirdupois, but by the British buyers they have had to be counted in hundredweights, quarters, and pounds, in accordance with our antiquated and absurd and anomalous system of weights. What is the consequence? To give a concrete example: The buyer wishes to ascertain, say, the weight of 100 pounds of tobacco; to do so the nearest weight he can employ is a quarter, or 56 pounds, to which must be added smaller weights until the exact quantity is ascertained. But two 50-pound weights will give him the exact amount at once; three will give him the weight of 150 pounds, four 200 pounds, and so on, smaller weights being used for fractions of 50 pounds. The consequence is an enormous simplification of calculation. It should be remembered that the men who weigh these materials at the docks are not, as a rule, mathematicians who can tell the time of day by algebra. They are largely day laborers, who have not had a superior education, and to weigh quantities with a set of weights necessitating the calculation of fractions of pounds, and thereby the use of dozens of small weights, necessitates a mental effort of which all are not capable, and the use of a multiplicity of weights which confuses them leads to errors and loss of time—and time is money. But by the adoption of a 50-pound weight a unit of calculation has been obtained which will sweep away a whole set of weights, prevent errors, and save confusion, time and money. It should be remembered that the present complicated and wasteful method of calculating weigths has to be gone through four times—first, when the goods are warehoused; second, by the customs, for the purpose of duty; third, in the counting-house; and fourth, in the factory —and in all these cases the same cumbrous system of calculation by hundredweights, quarters and pounds has to be gone through, and the loss of time, convenience and money quadrupled. But by the adoption of a 50-pound weight, though four separate calculations will still be necessary, they can be done simply and quickly. The savings in bookkeeping will alone be great. The present system necessitates a maze of figures of different denominations; but by their reduction to the one common denominator of pounds weight whole columns of figures will be saved and the risk of mistakes minimized.

Americans have great difficulty in understanding the English system of weights—almost as much as they encounter in trying to understand the English fractional system of coinage. For instance, if you ask a man here how much he weighs he will tell you, say, '11 stone 7.' A 'stone' is 14 pounds; so 11 stone would be 154 pounds, and adding the extra 7 pounds the weight given would be 161 pounds. Even Englishmen 'to the manner born' have to make a mental calculation in arriving at the result in pounds in such a case. Sometimes provisions and other articles are sold at so much a stone, and then if the quantity purchased weighs a few odd pounds over a stone or a number of stones the purchaser and seller have to figure out the price per pound. It is the hope and expectation that the results from the adoption of the new

standard weight of 50 pounds will be so satisfactory that before long the old-fashioned 'hundredweight' of 112 pounds will be entirely abolished along with the stone, and that a decimal fractional system of 5 pounds, 10 pounds, and 25 pounds will come into general use.

We learn from the London *Times* that the first meeting for the session of the Geologists' Association, held recently, took the form of a *conversazione*, held in the library of University College, London. The most important geological exhibits were the erratics from Hertfordshire, and the facetted pebbles from Berkshire and Oxfordshire, shown by Dr. Salter; the Hertfordshire pudding-stones by Mr. Green, and the iron, flint and lime concretions, closely resembling animal forms, sent by Dr. Abbitt. The small erratics are of great interest, as it is not easy to account for the presence of rhomboid porphyry of Norwegian origin on the uplands of Hertfordshire. On this subject Dr. Salter intends to publish a paper, advancing another theory than that generally accepted—the transportation by ice across the North Sea. The facetted pebbles of banded quartzite were probably worn down by a natural sand-blast. Anthropology was well represented. The Rev. R. Ashington Bullen showed prehistoric implements; as did Mr. Elliott, whose exhibits included photographs of and implements from the Mentone caves. Among the other exhibits were worked Chinese jade, collections of fossil mollusca, photographs and maps, and other objects of interest to students of geology.

The following books have recently been sold at auction in London: 'Catalogue of the Birds in the British Museum,' from Vol. 1 to Vol. 27, 1874–95, with numerous beautifully-colored plates, £32; the *Ibis*, from 1859 to 1903, with numerous colored plates and the general index, 1877–94, £60; 'Colored Figures of the Birds of the British Islands,' 1891–97, second edition, £63; H. E. Dresser, 'History of the Birds of Europe,' published by the author, 1871–96, with numerous colored plates, £61; two by John Gould, 'The Birds of Great Britain,' 1873, £58; 'Birds of Asia,' 1850–83, £75; 'English Botany,' 1790–94, 36 volumes, £18 15s.; W. C. Hewitson, 'Exotic Butterflies,' 1876, £19.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

Cornell University will receive more than $200,000 from the estate of the late Frederick W. Guiteau of Irvington-on-the-Hudson, which is nearly $50,000 more than was announced at the time of Mr. Guiteau's death last year. The money will be used as a fund for the assistance of needy students, and will be lent them without interest.

By the will of George Sykes, of Rockville, Conn., a fund of $100,000 is provided for a manual training school.

A new science hall, to cost $100,000 is to be erected at Colgate University. A sum of about $30,000 has been subscribed for the purpose.

The French minister of public instruction has recommended the establishment of a chair of physics at the University of Paris, to which M. Curie will be called.

In the report of the registration of the universities, recently published in Science, the number of students in the graduate school of the University of Michigan was given as 69. We are informed that it was at that time at least 85, and is now nearly 100.

Dr. Charles W. Dabney has accepted the presidency of the University of Cincinnati.

Dr. George Stuart Fullerton, professor of philosophy at the University of Pennsylvania and formerly dean and vice-provost, has been elected professor of philosophy at Columbia University.

At Teachers College, Columbia University, Dr. Edward L. Thorndike was promoted from an adjunct professorship to a professorship of psychology; Dr. J. H. MacVannell from an instructorship to an adjunct professorship in education, and Dr. Herman Vulté from a lectureship to an adjunct professorship of domestic science.

Mr. Gilbert Van Ingen has been appointed assistant in geology and curator in invertebrate paleontology at Princeton University.

Mr. Howard D. Minchin, of the University of Michigan, has been appointed instructor in physics at Rochester University.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 22, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *GEOGRAPHY IN THE UNITED STATES.*[*] *I.*

FOR twenty years past our section has acknowledged in its name an equal rank for geology and geography, but not one of the vice-presidential addresses during that period, or, indeed, since the foundation of the association over fifty years ago, has been concerned with the subject second named. Unless we cross off geography from the list of our responsibilities, it should certainly receive at least occasional attention; let me, therefore, depart from all precedents, and, even though geologists may form the majority in this gathering, consider the standing of geography among the sciences of the United States; how it has reached the place it now occupies, and what the prospects are for its further advance.

One measure of the place that geography occupies in this country may be made by considering the share that geographical problems have had in the proceedings of our association; here follow, therefore, the results of a brief examination of our fifty volumes of records. In the early years of the association there was no fixed division into sections. The meetings were sometimes so small that papers from various sciences were presented in general session. At least once in the early years the work of our predecessors was recorded under the general heading, 'natural history, etc.' As early as in 1851 there was a section of

* Address of the vice-president and chairman of Section E—Geology and Geography—of the American Association for the Advancement of Science, St. Louis meeting, December, 1903.

geology and physical geography, and another of ethnology and geography, but that classification did not endure. Once only, in 1853, did geography stand by itself as a sectional heading, but at many meetings physics of the globe and meteorology had places to themselves. Through the '60's and '70's geography was sometimes coupled with geology, but the latter more often stood alone or with paleontology, and it was not until the Montreal meeting of 1882 that Section E was definitely organized with the title that it now bears.

In those years when physics of the globe and meteorology were given sectional rank, problems concerning the ocean and the atmosphere received a good share of attention. It is curious to note, in contrast to this, how little consideration has been given to the exploration and description of the lands, that is, to the geography of the lands, in this Association for the Advancement of Science, either before or after the establishment of the double name for our section. The exploration of foreign lands, for many years a prominent subject in the meetings of the British Association, where geography has had a section to itself since 1869, has attracted hardly any notice in our gatherings; perhaps because we have been busy exploring our own domain. At the first meeting, 1848, a summary of then recent explorations, prepared by Alexander, is the only paper of its kind. Other papers treating the geography of foreign lands are so few in number that most of them may be noted here; in 1850, Squier gave an evening address on the volcanoes of Central America; in 1858 and 1860, Hayes and Wheildon discussed arctic exploration; Orton described the valley of the Amazon in 1869; in 1884 and 1898, two English visitors had papers on different parts of Asia; in 1891 and 1898, Crawford described features of Nicaragua; and in 1894 and 1895, Hubbard read papers on China, Corea and Japan. Even geological essays on foreign regions have been few; Dana, Branner, Hill, Spencer, Heilprin and Hitchcock being the chief contributors. Inattention to foreign exploration is, however, not to be fully explained by devotion to the geography of our own country, so far as the latter is measured by the pages devoted to it in our proceedings. The first meeting started well enough, with accounts of the terraces of Lake Superior by Agassiz, of the physical geography of northern Mississippi by Bolton, and of the topography of Pennsylvania and Ohio by Roberts. Again, in 1851, when physical geography was named with geology, the first subject had two essays, the distribution of animals in California, and the climate, flora and fauna of northern Ohio; and geography joined in the same year with ethnology had three rather scattering titles: a deep-sea bank near the Gulf Stream, measurement of heights by the barometer, and a geographical department in the Library of Congress; but this beginning had no worthy sequel. The many expeditions across our western territory contributed little geographic matter to our records; in 1856 Blake described the orography of the western United States, and Emory the boundary of the United States and Mexico; and the latter added in 1857 an account of the western mountain systems of North America. From that time onward there has been very little primarily of a geographical nature concerning the United States. Even the modern discussions of glacial geology in the last twenty years, profitable as they have been to the physical geographers of glaciated regions, have in very few, if any, cases been presented as contributions to geography. The new phase of the physiography of the lands is scantily represented; there have been

hardly more than accounts of Mexico by Hill, of California by Perrin Smith, of North Carolina by Cobb; it is to be noted, moreover, that these three authors are primarily geologists, not geographers. This meager showing leads one to suspect that our proceedings do not give a fair measure of geographical activity in North America.

There has been in reality a great deal of work of a geographical nature done by our people, but the proceedings of the association do not seem to have commended themselves as a place to put the work on record. Our geological surveys, state and national, have contributed numerous geographic chapters and reports of prime value; our weather bureau is in many respects the leading institution of its kind; our coast survey sets a high standard for triangulation, coast maps and tide current studies; we have held a prominent place in arctic exploration, and have taken some part in exploration elsewhere. But in spite of all this accomplishment, we have not made great contributions to the full-fledged science of geography. There are, for example, few steps toward scientific geography of greater value than good maps, but for the geographer to stop with the production of good maps is as if the botanist stopped with the collection of dried plants. The survey reports of our various states and territories contain a great fund of geographical matter, and some of the members of these surveys have carried the physical geography of the lands so far forward as to develop it into a new science, to which a name, geomorphy or geomorphogeny, has been given; yet geography has not flourished among us as a maturely developed subject. The survey reports have not, as a rule, been prepared by persons whose training and interests were primarily geographical, and very few of the geomorphogenists have carried their new science forward into a geographical relation; they have usually stopped with the physical aspects of the subject, and left the organic aspects with scanty consideration. It is as if there had been some impediment in the way of the full development of geography as a maturely organized science. There are in fact three serious impediments.

During all these years geography has suffered greatly from being traditionally a school subject in its educational relations; the subject as a whole has been almost everywhere omitted from the later years of college and university training, although certain of its component parts have received some attention in college years. Again, geography as a whole leads to no professional career outside of school-teaching; it is perhaps chiefly on that account that our colleges and universities can give little time to it. Finally, there is not to-day in this country an organized body of mature geographical experts at all comparable to the bodies of physicists or of zoologists who are organized into effective working societies; in the absence of such an organization geography suffers greatly for the lack of that aid which comes from mutual encouragement among its workers. How can we remove these impediments of low educational rank, no professional career and no professional organization?

Geography will find a place in our colleges and universities very soon after it is shown to be a subject as worthy of such a place as are the subjects whose position is already assured. Physical geography is to-day slowly winning a more respected place than it has ever had among the subjects on which examinations are set for admission to college. Commercial or economic geography is, I believe, destined to attract increasing attention from mature teachers and nearly mature students. The general geography of various parts of the world must receive more and more consid-

eration in our colleges during the century that opens with the outgrowth of our home country; and just so soon as mature teachers of mature geography can make their lectures of value to the young men of to-day, who are to be the leaders of enterprise to-morrow, place will be found for geographical courses in our higher institutions of learning. Progress in this respect is visible, though not rapid. In order to hasten progress, increased attention might well be given to so-called practical courses in geography, as well as to courses of a generally descriptive nature. The impediment of low educational rank is not permanent; it need not discourage us, for it is destined to disappear.

The study of geography is not likely soon to lead to a large, independent career, but it may be made useful in many careers, as has just been indicated. It will, however, be made particularly serviceable to a class of men that is now of small but of increasing numbers, namely, those who travel about the world, seeking fortune, entertainment or novelty. With the present rapid increase of wealth among us, this class is destined to grow, and while it may never be large, it may soon be important, and its members need careful cultivation; and at the same time the teachers of this class, and of other classes with whom geography becomes important, will win a respected career for themselves. The impediment arising from the lack of a large professional career will, therefore, have no great importance when the many relations of geography to other subjects are recognized.

The third impediment to the maturing of geography is the most easily overcome even if at present the most serious, for its removal depends only on the action of geographers themselves, and not on the action of higher bodies, such as executive officers, trustees and so on, or on the action of lower bodies, such as students. The absence of a society of mature geographical experts is the fault of the experts themselves. No greater assistance to the development of mature scientific geography lies within our reach than the establishment of a geographical society which shall take rank with the Geological Society of America, for example, as a society of experts, in which membership shall be open only to those whose interests are primarily geographical and whose capacity has been proved by published original work in a distinctly geographical field. In order to determine whether such a society can now be organized, I propose to consider the classes of persons in the community from which the members of the society could be recruited.

There are at least four classes of geographical associates, as they may be called, from which mature geographical experts might be drawn. First and in largest number is the class consisting of the teachers of geography in our schools. It is true that our school-teachers, as a rule, devote themselves to immature geography; that is, to only so much of the whole content of the subject as can be understood by minors, indeed by children. But, on the other hand, one who is acquainted with recent educational progress can not fail to recognize the notable advance made in the last ten years alone in the preparation for and in the performance of geographical teaching. There are in the secondary schools to-day a number of teachers who are competent to make original, mature geographical exploration of their home country, and some of them have actually traveled east and west with the object of making geographical studies. There are several teachers' geography clubs, and the leading members of these clubs are thoughtful workers. I am sure that a significant number of ac-

ceptable members of an expert geographical society would be found in this class.

The second class of geographical associates includes the observers of the national and state weather services, who have chiefly to do with that important branch of geography comprehended under climatology; these observers are gathering a great crop of facts, not always very accurately determined or very widely applied as far as the observers in the state services are concerned; yet from among the thousands of persons thus employed there will now and then come forth the original worker whose contribution will fully entitle him to expert rank; when his published studies are seen to be of a thoroughly geographical character and of a mature grade, they would warrant his admission to a society of geographical experts.

Third comes the class made up from the members of various governmental bureaus, state and national, whose work is of a more or less geographical character; for example, topographers and hydrographers, geologists and biologists, ethnologists and statisticians; this class being as a whole of much higher scientific standing than the two classes already mentioned. It may happen that many persons thus classified have a first interest in the strictly geographical side of their studies, although faithful work in the organization to which they belong associates them with other sciences. I should expect the greatest part of the membership in a society of geographical experts to be drawn from this class.

It may be noted that the absence of a body of mature geographers, as well organized and as scientifically productive as are the workers in various other sciences, is explained by some as an inherent characteristic of geography, necessitated by the great diversity of its methods and its interests. The diversity is already an embarrassment, it is claimed, even in school years; and it afterwards compels the separation of the branches of this highly composite subject, at best but loosely coherent, into a number of specialities, each of which is so much more closely allied to other sciences than to the other branches of geography, that those workers whose union would constitute a body of mature geographical experts are found scattered among other unions, geological, botanical, zoological, ethnological, economical and historical. The claim that the disunion of geographical experts is necessary does not seem to me well founded. May we not, indeed, prove that there is no such disunion by pointing to the fourth class of geographical associates, concerning whom my silence thus far may perhaps have awakened your curiosity, namely, the members of our various geographical societies?

There are at the present time between five and seven thousand such persons in the United States, but in the absence of any standard of geographical knowledge from the requirements for membership, these societies can not, I regret to say, be taken as evidence that there is a common bond by which experts in all branches of geography are held together. None of our geographical societies is composed solely of experts, and none of them is held together by purely geographical bonds. While we must not overlook the excellent work that our geographical societies have done, neither must we overlook the fact that in making no sufficient attempt to require geographical expertness as a condition for membership, there is a very important work that the societies have left undone. They have truly enough cultivated a general interest in subjects of a more or less geographical nature, but they have failed to develop geography as a mature science. Indeed, it may be cogently

maintained that the absence of any standard of geographical knowledge as a condition for society membership has worked as seriously against the development of mature scientific geography as has the general abandonment of geographical teaching to the secondary schools. Large membership seems to be essential to the maintenance of good libraries in handsome society buildings, and it is certainly helpful in the collection of funds with which journals may be published and with which exploring expeditions may be equipped and sent out. I should regret to see the membership in a single existing geographical society decreased, but I regret also that there is no geographical society of the same rank as the American Mathematical Society, the American Physical Society or many others in which number of members is secondary to expert quality of members. Large numbers of untrained persons are not found necessary to the maintenance of vigorous societies in which these other sciences are productively cultivated, and it is, therefore, reasonable to believe that large numbers would not be essential to the formation of a geographical society of high standing. Indeed, it can hardly be doubted that the acceptance of a low standard for membership in our geographical societies has had much to do with the prevailing indifference regarding the development of a high standard for the qualification of geographical experts.

Not only may any respectable person obtain membership in any of our geographical societies, however ignorant he may be of geography, but various kinds of societies are ranked as geographical, even though their object may be geographical in a very small degree. This is indicated by a list of geographical societies recently published, in which is included a small travelers' club lately organized in one corner of our country. The object of this club is simply 'the encouragement of intelligent travel and exploration.' Interest in rather than accomplishment of exploration and travel suffice to recommend a candidate, otherwise qualified, for membership. The object of travel is nowhere stated to be geographical. As a matter of fact, travel for the sake of art, archeology, language, history, astronomy, geology and botany, for discovery, or even only for sport and adventure, as well as for strictly geographical objects, is encouraged by this young organization, which is really nothing more than its name claims it to be: a travelers' club. The same list of geographical societies includes several clubs of excursionists, outing-takers or mountain climbers, among whom, as a matter of fact, geography attracts hardly more interest than botany. These societies are doing an excellent work in taking their members outdoors, sometimes on walks near home, sometimes farther away to a hotel in the country, sometimes to a camp among the mountains. The chief result of such outings is an increased enjoyment and appreciation of the landscape, of natural scenery and of everything that enters into it; but this excellent result is by no means exclusively, perhaps not even largely, geographic in its quality.

One might question whether geographic rank was really accorded to these clubs by general assent, if their recognition in the group of geographical societies were expressed only by an individual opinion in the list referred to; but this is not the case. In preparation for the meeting of the International Geographical Congress, to be held in this country next summer, delegates to the committee of management have been invited from the Appalachian Mountain Club, in one corner of the country, and from the Mazamas in another. The delegates appointed by these clubs are, as might have been expected, men compe-

tent to act with the others in organizing the congress for us, but the same result would have been attained if delegates had been asked from the various geological, botanical, zoological and historical societies, for all these societies contain among their members persons of a certain amount of geographical knowledge and of a sufficient executive ability. The same would be true had delegates been invited from the Boone and Crocket Club, a choice organization of sportsmen, for all such clubs have men of undoubted ability in the way of organization among their members, and are largely concerned with matters of geographical location and distribution in their activities. Nevertheless, neither the sporting nor the outing clubs are essentially or characteristically geographical in their objects. Do not, however, understand me to object to the acceptance of delegates from the above-named clubs as members of the committee on management of the International Geographical Congress. I approve of the plan heartily; for in the absence of geographical societies in many parts of our country there was no other plan so appropriate. The matter is mentioned here only to show the straits to which geographers are reduced in attempting to give a national welcome to an international geographical congress; the difficulty, so far as it is a difficulty, arises from the absence among us of a body of mature geographical experts, united in an advanced acquaintance with some large part of a well-defined science. This condition of things seems to me unsatisfactory. The absence of a strong society of geographical experts indicates an insufficient attention to scientific geography, and I, therefore, now turn to consider the direction in which serious efforts may be most profitably made toward a better condition of things. Let it be understood, however, that no quick-acting remedy is possible, for the reason that many of those concerned with the problem—namely, the advance of scientific geography—do not seem to recognize that the existing state of things needs a remedy. It is, therefore, only as a change of heart—a scientific change of the geographic heart—makes itself felt that much can be accomplished toward the development of scientific geography, and such a change is notoriously of slow accomplishment. Progress is apparent, however, and from progress we may gather encouragement. In what direction, then, shall our further efforts be turned?

Let me urge, in the first place, that close scrutiny should be given to things that are properly called geographical, with the object of determining the essential content of geographical science and of excluding from our responsibility everything that is not essentially geographic. Only in this way can we clear the ground for the cultivation of really geographical problems in geographical education and in geographical societies. This scrutiny should be exercised all along the line: in the preparation of text-books, in the training of teachers, in the study of experts, and in the conduct of any geographical society that attempts to take a really scientific position. The essential content of geographical science is so large that the successful cultivation of the whole of it demands all the energies of many experts. Those who are earnestly engaged in cultivating geography proper should treat non-geographic problems in the same way that a careful farmer would treat blades of grass in his cornfield: he would treat them as weeds and cut them out, for however useful grass is in its own place, its growth in the cornfield will weaken the growth of the corn. So in the field of geographical study, there is no room for both geography and history, geography and geology, geography and astronomy. Geography will never gain the

disciplinary quality that is so profitable in other subjects until it is as jealously guarded from the intrusion of irrelevant items as is physics or geometry or Latin. Indeed, the analogy of the blades of grass in the cornfield is hardly strong enough. It is well known that Ritter, the originator of the causal notion in geography, and, therefore, the greatest benefactor of geography in the nineteenth century, was so hospitable in his treatment of history that his pupils grew up in large number to be historians, and his own subject was in a way lost sight of by many of his students who became professors of geography, so-called, in the German universities, until Peschel revolted and turned attention again to the essential features of geography proper.

Close scrutiny of what is commonly called geography will certainly be beneficial in bringing forward the essence of the subject and in regulating irrelevant topics to the background; but it is not to be expected that any precise agreement will soon be reached as to what constitutes geography, strictly interpreted. Opinions on the subject, gathered from different parts of the country, even if gathered from persons entitled to speak with what is called 'authority,' would probably differ as widely as did the nomenclatures of the leading physiographic divisions of North America as proposed in a symposium a few years ago; but if careful consideration and free discussion are given to the subject, unity of opinion will in due time be approached as closely as is desirable.

As a contribution toward this collection of opinions, let me state my own view: the essential in geography is a relation between the elements of terrestrial environment and the items of organic response; this being only a modernized extension of Ritter's view. Everything that involves such a relationship is to that extent geographic. Anything in which such a relationship is wanting is to that extent not geographic. The location of a manufacturing village at a point where a stream affords water-power is an example of the kind of relation that is meant, and if this example is accepted, then the reasonable principle of continuity will guide us to include under geography every other example in which the way that organic forms have of doing things is conditioned by their inorganic environment. The organic part of geography must not be limited to man, because the time is now past when man is studied altogether apart from the other forms of life on the earth. The colonies of ants on our western deserts, with their burrows, their hills, their roads and their threshing floors, exhibit responses to elements of environment found in soil and climate as clearly as a manufacturing village exhibits a response to water-power. The different coloration of the dorsal and ventral parts of fish is a response to the external illumination of our non-luminous earth. The word *arrive* is a persistent memorial of the importance long ago attached to a successful crossing of the shore line that separates sea and land. It is not significant whether the relation and the elements that enter into it are of easy or difficult understanding, nor whether they are what we call important or unimportant, familiar or unfamiliar. The essential quality of geography is that it involves relations of things organic and inorganic; and the entire content of geography would include all such relations. A large library would be required to hold a full statement of so broad a subject, but elementary text-books of geography may be made by selecting from the whole content such relations as are elementary, and serviceable handbooks may be made by selecting such relations as seem important from their frequency or their significance. The essen-

tial throughout would, however, still be a relation of earth and life, practically as Ritter phrased it when he took the important step of introducing the causal notion as a geographical principle.

Thus defined, geography has two chief divisions. Everything about the earth or any inorganic part of it, considered as an element of the environment by which the organic inhabitants are conditioned, belongs under physical geography or physiography.* Every item in which the organic inhabitants of the earth—plant, animal or man—show a response to the elements of environment, belongs under organic geography. Geography proper involves a consideration of relations in which the things that belong under its two divisions are involved.

The validity of these propositions may be illustrated by a concrete case. The location and growth of Memphis, Helena and Vicksburg are manifestly dependent on the places where the Mississippi River swings against the bluffs of the uplands on the east and west of its flood plain. The mere existence and location of the cities, stated independently of their controlling environment, are empirical items of the organic part of geography, and these items fail to become truly geographic as long as they are stated without reference to their cause. The mere course of the Mississippi, independent of the organic consequences which it controls, is an empirical element of the inorganic part of geography, but it fails to become truly geographic as long as it is treated alone. The two kinds of facts must be combined in order to gain the real geographic flavor. Geography is, therefore, not simply a description of places; it is not simply an account of the earth *and* of its inhabitants, each described independent of the other; it involves a relation of some element of physical geography to some item of organic geography, and nothing from which this relation is absent possesses the essential quality of geographical discipline. The location of a cape or of a city is an elementary fact which may be built up with other facts into a relation of full geographic meaning; but taken alone, it has about the same rank in geography that spelling has in language. A map has about the same place in geography that a dictionary has in literature. The mean annual temperature of a given station, and the occurrence of a certain plant in a certain locality, are facts of kinds that must enter extensively into the relationships with which geography deals; but these facts, standing alone, are wanting in the essential quality of mature geographical science. Not only so; many facts of these kinds may, when treated in other relations, enter into other sciences; for it is not so much the thing that is studied as the relation in which it is studied that determines the science to which it belongs. I, therefore, emphasize again the broad general principle that mature scientific geography is essentially concerned with the relations among its inorganic and organic elements; among the elements of physical and of organic geography, or, as might be said more briefly, among the elements of physiography and of ——. Let me confess to the most indulgent part of this audience that I have invented a one-word name for the organic part of geography, and have found it useful in thinking and writing and teaching; but inasmuch as the ten, or at the outside twelve, new words that I have introduced as technical terms into the growing subject of physiography have given me with some geological critics the reputation of being reckless in regard to terminology, it will be the part of prudence not to mention the new name for

* It should be noted that the British definition of physiography gives it a much wider meaning than is here indicated.

organic geography here, where my audience probably consists for the most part of geologists.

There can be no just complaint of narrowness in a science that has charge of all the relations among the elements of terrestrial environment and the items of organic response. Indeed, the criticism usually made upon the subject thus defined is, as has already been pointed out, that it is too broad, too vaguely limited and too much concerned with all sorts of things to have sufficient unity and coherence for a real science. Some persons, indeed, object that geography has no right to existence as a separate science; that it is chiefly a compound of parts of other sciences; but if it be defined as concerned with the relationships that have been just specified, these objections have little force. It is true, indeed, that the things with which geography must deal are dealt with in other sciences as well, but this is also the case with astronomy, physics, chemistry, geology, botany, zoology, history, economics. * * * There is no subject of study whose facts are independent of all other subjects; not only are the same things studied under different sciences, but every science employs some of the methods and results of other sciences. The individuality of a science depends not on its having to do with things that are cared for by no other science, or on its employing methods that are used in no other science, but on its studying these things and employing these methods in order to gain its own well-defined object. Chemistry, for example, is concerned with the study of material substances in relation to their constitution, but it constantly and most properly employs physical and mathematical methods in reaching its ends. Botanists and zoologists are much interested in the chemical composition and physical action of plants and animals, because the facts of composition and action enter so largely into the understanding of plants and animals considered as living beings. Overlappings of the kind thus indicated are common enough, and geography, as well as other sciences, exhibits them in abundance. It may be that geography has a greater amount of overlapping than any other science; but no valid objection to its content can be made on that ground; the maximum of overlapping must occur in one science or another—there can be no discredit to the science on that account. Geography has to do with rocks whose origin is studied in geology; with the currents of the atmosphere, whose processes exemplify general laws that are studied in physics; with plants and animals, whose forms and manner of growth are the first care of the botanist and zoologist; and with man, whose actions recorded in order of time occupy the historian; but the particular point of view from which the geographer studies all these things makes them as much his own property as they are the property of any one else.

In view of what has been said, let me return to the close scrutiny that I have urged as to what should be admitted within the walls of a geographical society. We will suppose the geography of Pennsylvania is under discussion; as a result there must be some mention of the occurrence of coal, because coal, now an element of inorganic environment, exerts a control over the distribution and the industries of the population of Pennsylvania. But the coal of Pennsylvania might be treated with equal appropriateness by a geologist, if its origin, its deformation and its erosion were considered as local elements in the history of the earth; by a chemist, if its composition were the first object of attention; by a botanist, if the ancient plants that produced the now inorganic coal-beds were studied. Furthermore, it

would be eminently proper for the geologist to make some mention of the present uses to which coal is put; or for the chemist and the botanist to tell something of the geological date when coal was formed, if by so doing the attention of the hearer could be better gained and held, and if the problem at issue could thereby be made clearer and more serviceable. So the geographer is warranted in touching upon the composition, the origin, the exploitation of the Pennsylvania coal-beds, if by so doing he makes a more forcible presentation of his own problem; but if he weakens the presentation of his own problem by the introduction of these unessential facts, still more if he presents these unessential facts as his prime interest, he goes too far. The point of all this is that students in many different sciences may have to consider in common certain aspects of the problems presented by the coal of Pennsylvania; but that each student should consider Pennsylvania coal in the way that best serves his own subject. The scrutiny that I have urged would, therefore, be directed chiefly to excluding from consideration under geography the non-geographic relations of the many things that various sciences have to study in common, and to bringing forward in geography all the problems that are involved in the relations of the earth and its inhabitants. The things involved in the relations of earth and life are the common property of many sciences, but the relations belong essentially to geography. It would be easy to point out topics in text-books and treatises, in the pages of geographical journals and in lectures before geographical societies, that would not fall under any division of geography as here defined. In many such cases, however, the topics might without difficulty have been given a sufficiently geographical turn, had it been so desired or intended; the topics might have been presented from the geographical point of view, so as to emphasize the essential quality of geographical study, had there been a conscious wish to this end. But in other cases, the subjects presented belong so clearly elsewhere, or are treated so completely from some other than a geographical point of view, as to fall quite outside of geography; for example, a recent number of one of our geographical journals contained an excellent full-page plate and a half page of text on the 'Skull of the Imperial Mammoth,' with brief description of its size and anatomy, but with nothing more nearly approaching geographical treatment than the statement that the specimen came from 'the sands of western Texas.' In all such cases it is open to question whether close scrutiny as to inclusion and exclusion has been given, and while the policy pursued by many geographical societies of generously accepting for their journals many sorts of interesting articles has something to commend it in the way of pleasing a mixed constituency, it is, nevertheless, open to the objection of not sufficiently advancing the more scientific aspects of geography. Blades of grass and mammoth skulls are very good things, if crops of hay and collections of fossils are to be gathered; but they are in the way of the growth of the best corn and of the publication of the best geographical journals. Let no one suppose, however, that the audiences in geographical lecture halls or the readers of geographical journals need suffer under the scrutiny that is here urged regarding lectures and articles. There is, even under the strictest scrutiny, an abundance of varied and interesting matter of a strictly geographical nature; few, if any, sciences are richer than geography in matter of general interest. There is, indeed, some reason for thinking that the real obstacle in the way of applying close scrutiny in the way here recom-

mended is the difficulty of obtaining high-grade material presented in an essentially geographical form. Inasmuch as this difficulty arises from the relative inattention to geography as a mature science, it is the business of geographical societies to remove the difficulty.

W. M. Davis.

Harvard University.

(*To be concluded.*)

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*SOME UNSOLVED PROBLEMS OF ORGANIC ADAPTATION.**

With the advent of the 'Origin of Species' became current the naturalistic interpretation of organic nature, epitomized in such phrases as 'natural selection,' 'survival of the fittest,' etc. So rapid and general was the acceptance of this conception as a working hypothesis that in thirty years, or within a single generation, Wallace made bold to claim for it universal recognition in the well known and oft-quoted declaration, 'He (Darwin) did his work so well that descent with modification is now universally accepted as the order of nature in the organic world.'

As a general statement of the fact of evolution, as the phrase may be literally interpreted, it may, after fifteen additional years of intense biological activity, be as vigorously claimed and as readily conceded. If, however, it be so interpreted as to include the full content of Darwinism and the all-sufficiency of natural selection as the prime factor, with its details of endless adaptations to environment, whether physical or physiological, it need hardly be said that consent would be far less general or prompt.

Moreover, with the highly metaphysical and speculative deductions which, under the caption of 'Neo-Darwinism,' or, more plainly, 'Weismannism,' which have boldly assumed the omnipotence and all-sufficiency of natural selection to account for the least and last detail of organic differentiation or constancy, widespread doubt and open protest are too common to elicit surprise or comment.

It need hardly be pointed out at this late day, though it is more or less persistently ignored, that primitive Darwinism, while essaying to explain the origin of *species,* and emphasizing the importance of natural selection as a means in the process, did not in the least presume to account for the origin of *variation* and *adaptation,* which were recognized as fundamental and prerequisite in affording conditions without which natural selection must be hopelessly impotent. Nor, moreover, should it be overlooked that while recognizing the inseparable correlation of the factors just mentioned and their essential utility either to the individual or species in the majority of cases, Darwin was free to concede and frank in declaring the efficiency of many other factors in the intricate and complicated problems of organic evolution.

The recent impulse which has come to biologic progress by experimental methods, and the remarkable results which have been attained thereby, may without exaggeration be said to have raised anew many an earlier doubt as well as brought to light problems apparently beyond the scope of the older explanations. It may not, therefore, be an extravagant assumption to announce the entire question of organic adaptations as open for reconsideration, in the light of which no apology will be necessary for directing attention to certain phases of the subject upon the present occasion.

Among the many problems which recent investigations and conclusions have brought into better perspective as well as sharper definition, and which might profitably be discussed, the limits of a single address preclude any very wide range of

* Address of the vice-president and chairman of Section F, Zoology, St. Louis meeting, 1903.

review. I have, therefore, chosen to restrict my discussion chiefly to problems of coloration among lower invertebrates, including incidental references to correlated subjects, and the probable limitations of color as a factor in organic adaptation.

Interesting as it might be to glance at the earlier views of a subject, the nature of which from earliest times must have been a source of keen interest to mankind in general, and which must have appealed to the esthetic and rational nature, inspiring not only poetic imagery, but admiring awe and a devout fervor akin to reverence, it must suffice in the present discussion to hold attention well within the period of thought immediately concerned, which, as already indicated in the opening paragraph, was brought into prominence by the 'Origin of Species.'

As is perfectly well known, color in nature is due to one of two causes, or to a combination of both, namely: (1) What has been termed optical or structural conditions, such as diffraction, interference or unequal reflection of light, examples of which are familiar in the splendid hues of the rainbow, the iridescent sheen and metallic colors of the feathers of many birds, wings of insects, etc. (2) What are known as pigmentary colors, due to certain material substances lodged within the tissues of animals or plants which have the property of absorbing certain elements of light and of reflecting others, and thereby producing the sensation of color. While the two are physically quite distinct it is not unusual to find them associated in producing some of the most exquisite color effects of which we have knowledge. In a general way one may usually distinguish between these two sorts of color by noting that those which are purely optical in their character produce a constantly changing impression as the relative position of object or observer may happen to vary with reference to the angle and direction of light; while, upon the other hand, colors which are due to pigments show this property very slightly or not at all, and that, moreover, pigment colors are usually more or less soluble in various reagents, such as alcohol, ether, acids, alkalies, etc., and that they often fade rapidly under the influence of strong light or in its absence, or upon the death of the organism.

The presence of many and various colors in inorganic nature, the large majority of which are due to purely physical causes, such as the colors of the ocean, the sky, the clouds, the mineral or gem, while appealing to our sense of beauty elicit no special inquiry as to their significance or purpose. It suffices to know that they are constitutional or structural, inseparable from the physical conditions in which they have their place.

It is different, however, with much of the color found in the organic world. While such colors as those of the grass or leaf might seem to have hardly any different significance or to call for special explanation different from the preceding, as Wallace has pointed out, on the other hand, as he has also forcefully expressed it: "It is the wonderful individuality of the colors of animals and plants that attracts our attention—the fact that colors are localized in definite patterns, sometimes in accordance with structural characters, sometimes altogether independent of them; while often differing in most striking and fantastic manner in allied species. We are, therefore, compelled to look upon color not merely as a physical but also as a biological characteristic, which has been differentiated and specialized by natural selection, and must, therefore, find its explanation in the principle of adaptation or utility."

It is under the stimulus of this conception that the significance of color has come

to have the large place and concern in the literature of evolution which it at present occupies, as expressive of which such well-known phrases as 'protective coloration,' 'warning colors,' 'mimicry,' etc., have come to be household commonplaces among us. It is not surprising, therefore, that in a book like Wallace's 'Darwinism' out of a total of some 475 pages more than 150 should be devoted to this phase of the problem alone, while it has frequent reference in other connections.

And the same is largely true of much of the literature dealing with the subject of organic colors. In other words, color in these relations has been studied largely, if not wholly, as a factor in adaptation—fitting the animal better to meet the exigencies of life in the struggle for existence, in certain cases serving as a disguise or screen against detection, in others by glaringly advertising some noxious quality, in still others by flying a signal of alarm or warning, and in flight serving to segregate the members of a herd in whose collective aggregate a larger measure of protection might be realized.

Hence it naturally came to pass that color was looked upon largely as a physical factor in the sum total of the animal's morphology which must have some fundamental relation to the adaptation or fitness for survival of the species. It is not strange, under prevailing conditions, that small attention was directed to the more fundamental problem of the *physiological* significance of color, or the part it has to do in the processes of metabolism of the individual organism. Recent work in experimental morphology has directed attention to this phase of the problem, and one of the objects of the present discussion will be to make somewhat more evident a too long neglected aspect of animal biology.

It ought not to be overlooked in this connection that along with the development in experimental morphology to which reference has been made, those of organic chemistry, and particularly chemical physiology, have been perhaps equally important in directing attention to certain phases of our problem. Nor ought we to forget that the spectroscope has thrown its light upon the same general problem, though with perhaps less of conclusiveness than could have been desired. As a result of this growing activity there has been accumulated a body of information, a part of which stands directly related to the subject under consideration, and a part indirectly concerned with the same essential principles, and from it we may safely predict the solution of problems hitherto only predicated hypothetically, and such side-lights upon others equally important that it is not too much confidently to forecast substantial progress all along the line.

It may be well in this connection to glance briefly at some of the results at present known as in some measure justifying these somewhat optimistic assumptions, as well as pointing the line along which important and promising researches may be prosecuted.

The work of Krukenburg, MacMun, Macallum, M'Kendric, Hopkins, Urech, Eisig, Cunningham and a host of others, comprising a mass of literature of enormous proportions, will be available to those interested and may afford some faint conception of the magnitude and importance of the field to be explored, as well as an introduction to that already made available. And while as a result of this activity many and various organic pigments have been isolated and their composition in part or entirely made known, it must be recognized that the task of the chemical analysis of any such highly complex compounds as most of these are known to be is attended with extreme difficulty and no small measure of uncertainty. Still, it

has been possible fairly to distinguish several classes of such pigments, differentiated physiologically as follows:

1. Those directly serviceable in the vital processes of the organism. Under this head may be classed such pigments as hæmoglobin, chlorophyll, zoonerythrin, chlorocruorin and perhaps others less known. It need not be emphasized that by far the most important of these are the two first named. The others, found chiefly among the lower invertebrates, are believed to serve a function similar to the first.

2. Waste products. Among these the several biliary products are too well known to call for special note. Guanin is a pigment of common occurrence in the skin of certain fishes and is associated with the coloration of the species. Similarly certain coloring matters have been found in the pigments of many lepidoptera, known as lepidotic acid, a substance closely allied to uric acid and undoubtedly of the nature of a waste product.

3. Reserve products. Of these there are several series, one of which, known as lipochrome pigments, is associated with the metabolism involved in the formation of fats and oils. Perhaps of similar character are such pigments as carmine, or rather cochineal, melanin, etc. It may be somewhat doubtful whether these pigments do not rather belong to the previous class, where should probably be listed such products as hæmatoxylin, indigo, etc., all of which have been claimed as resultants of destructive metabolism in process of being eliminated from the physiologically active tissues of the body of the organism. Of similar character is probably tannic acid, a substance well known among plant products and involved in the formation of many of the brownish and rusty colors of autumn foliage, particularly of the oaks and allied trees, as are the lipochromes in the formation of the reds and yellows which form so conspicuous a feature among autumn colors.

While the association of these and other pigmentary matters has long been known in connection with both animal and plant growth, and while the conception of their more or less intimate relation to the active metabolism of the various tissues is not new, comparatively little has been done toward directly investigating and elucidating the exact nature and extent of the process. This seems to be especially the case in relation to the part played by these products in the formation of those features of coloration among organisms with which we are now concerned.

The most strenuous advocates of the primary importance of natural selection as the chief or only factor in adaptation are free to admit that among the simplest forms particularly, color has originated in some more or less obscure way through growth or some of the vital activities of the organism, Darwin, for example, merely suggesting that 'Their brightest tints result from the chemical nature or minute structure of their tissues,' and Wallace in the even less explicit statement that 'color is a normal product of organization,' whatever that may imply.

So far as I am aware Eisig was among the earliest to claim that among certain annelids the colors were primarily expressions of the katabolic processes of the tissues, and were excretory in character. He was able largely to demonstrate this with species of Capitellidæ by experimental methods. By feeding the animals with carmine he was able to follow its course through the alimentary tract, its progress through the tissues, and final deposition in the hypodermal tissues beneath the cuticle, where in the process of moulting it was finally eliminated. He also found that in a species of *Eunice,* which fed upon sponges, the pigment granules of the food

passed unchanged through the intestine and into the body tissues much as had been the case in the experiments with the preceding.

Graff later reached very similar conclusions concerning coloration in the leeches, but was able to go a step farther than Eisig had done and to show in great detail the exact process through which it was brought about. He found in the endothelium certain migratory cells which wander about in the cœlom or penetrate through the tissues, and that among their functions one of the most important seems to be the absorption of foreign bodies and their conveyance into the mouths of the nephridia or through the tissues to the hypodermis and their lodgment in that tissue. He was even able to show that the special markings or color patterns which are so characteristic of the animals may be explained by the disposition of the muscle bands, and their relation to the lines of pigmentary deposition by the wandering cells, which Graff has designated 'excretophores.' He was also able to confirm the results of Eisig as to the experimental demonstration of feeding with various pigmentary matters, and subsequently tracing them from point to point in the process of elimination. Furthermore, he showed that the amount and density of pigmentation was closely related to the intensity of metabolism, being greatest in those specimens which were most voracious feeders.

Observations of a similar character have been made upon certain of the protozoa, particularly upon *Stentor*. Schuberg in 1890 found that the blue-green pigment so characteristic of this organism was constantly being excreted bodily in the form of definite granules.

In 1893 Johnson, in an extended study of the morphology of these protozoa, confirmed the preceding observations, and showed that the pigment was excreted along with other excrementitious matter. He found also that the principal region of excretory activity was at the base of the animal, where was formed after a short time a definite mass of debris near the foot.

Perhaps one of the most important contributions along this line is that of Harmer on the character of the 'brown body' of the polyzoa. By a series of critical observations upon the life-history of these interesting organisms and painstaking experiments in feeding with carmine and other pigments, he was able to prove beyond reasonable doubt that the so-called 'brown body' of the polyzoa is a direct product of the destructive metabolism within the body and its excretion in a mass at this particular region. He found that the leucocytes of the funicular organ as well as certain cells of the organ itself engulfed pigmentary wastes, and with the periodic decline of the polypides these cells became crowded into a close mass, thereby constituting the 'brown body.' The new polypide arising by a sort of regenerative process was found to be always devoid of any coloration, no pigment appearing for some time following the activity of the new polypide, but that it is formed in regularly increasing amounts with the age and degree of metabolism of the organisms.

Correlated with these views concerning the origin of certain colors and their disposition in the organism is that of the relation of coloration to the food. It has long been known that in many cases there is a more or less intimate relation of color to the food consumed by certain animals. Instances of this are too numerous for detailed consideration here. Let it suffice that Darwin, Semper, Eimer, Koch, Beddard, Poulton, Gunther and many others have, by extended observations and by detailed experimentation, apparently established the general fact. Beddard quotes the following observation made by G.

Brown-Goode as to such an explanation of protective coloration in fishes. "On certain ledges along the coast of New England are rocks covered by dense growths of scarlet and crimson seaweeds. The codfish, the cunner, the sea raven, the rock eel, and the wrymouth, which inhabit these brilliant groves, are all colored to match their surroundings; the cod, which has naturally the lighter color, being most brilliant in its scarlet hues, while others whose skins have a large and original supply of black have deeper tints or dark red and brown." He then quotes farther the suggestions of Goode that these colors are due to pigment derived either directly or indirectly from the red algæ; those which are carnivorous feeding upon the crustacea and other marine organisms whose stomachs are full of the algæ and their pigments which pass unchanged into the tissues of the fishes.

He also quotes a similar conclusion of Gunther as to the origin of the red pigment of the salmon being derived from the red pigment of the crustacea upon which it feeds. While admitting that in the cases just cited there has been no attempt at demonstration of the proposed explanation, it yet would seem highly probable. "It is too remarkable a coincidence that the fish normally with but little pigment should when among these weeds be *bright red,* and that the fish normally possessing black pigment should be *dark red,* to permit of a settlement of the question offhand by the easy help of natural selection —without at least some further inquiry."

With the foregoing considerations concerning the general origin and development of pigments and their relations to the colors of organisms, we may next proceed to pass rapidly in review such groups of animals as we may choose to consider, and may institute a brief inquiry as to the significance of their types of coloration as factors of adaptation.

With the avowed purpose of restricting my observations and discussion as far as practicable to the lower groups of invertebrates as already announced, it will suffice to say further that in justification of such a course I am constrained to consider the lower animals, particularly cœlenterates, as more favorable subjects from which to obtain fundamental conclusions than are the more highly specialized insects or birds which have had so large a measure of attention in earlier investigations along these lines.

Furthermore, it seems highly probable that future investigations will involve more of direct experimentation than has hitherto been the case, and if so, these lower series will naturally afford some of the best material available for such inquiries, not only because of the more ready and rapid responses obtained, but from the relative simplicity of their organization and the consequent simplicity of results likely to be obtained in each case.

If further warrant were demanded for a comparatively limited survey, or special emphasis upon a limited group of animals, I should find it in a measure in the personal interest and familiarity which has come from special researches connected therewith.

Beginning with the hydrozoa it may be noted in the outset that though including the simplest of the Cœlenterates we shall find a remarkable variety and range of coloration. Among the hydroids, as is well known, coloration is neither very remarkable as to brilliance nor distribution. Many, if not most, are almost without color distinction, except in the dull brownish or amber colors found in such as *Obelia, Halecium,* and other campanularians. This may be due in part to the fact that the colonies are so generally encased within a chitinous perisarc which, while somewhat colored as already indicated, is

seldom if ever of any considerable brilliance or diversity. Among the tubularians, in many of which the development of a perisarc is slight, and always lacking over the hydranth itself, there is often found considerable coloration, as in *Eudendrium, Pennaria, Corymorpha* and others. And in these color is usually found associated more particularly with the development of the sexual products, or during the season of reproductive activity, which is a matter of considerable significance, to be taken up in a later connection.

As is well known, the predominance of alternation of generations in these animals brings into prominence the sexual phase, which in most species is an independent organism—the medusa. And it is in connection with the medusæ that we find the most marked development of color. There does not, however, appear to be any well-defined distribution of colors into patterns. Among the Hydromedusæ the distribution of pigment, which is almost the only conspicuous kind of color present, is chiefly in association with the gonads, the tissues of the stomach and the regions of the chymiferous canals, though in some cases also extending to the tentacles and in the regions of the sensory organs. It should not be overlooked, however, that in many of these medusæ the color tints are among the most beautiful and delicate known, though lacking the intensity more common among the Scyphomedusæ and corals.

Turning attention to the Scyphomedusæ we find as just suggested a more copious development of color, and also what is more significant, in many cases its distribution into something like definite patterns, as is more or less evident in such genera as *Cyanea, Pelagia* and *Rhizostoma.* It is, however, no less evident that among these we have, as in the former, the deposition of pigment along the lines of most active metabolism, such as the gastrovascular and reproductive organs, in most abundance and usually of greatest brilliance.

It is, however, when we come to the Anthozoa, which includes the corals, actinians, sea-fans, etc., that we find the climax of coloration, both as regards brilliance and intensity. To look into the crystalline depths of the waters about a coral reef where these varied forms thrive in great garden-like areas is to gaze upon a scene, the fairy-like features of which it would be difficult to exaggerate. Here are actinians, corals, sea-fans, sea-feathers, etc., which abound in the richest profusion and endless variety, seeming to vie with each other in the effort to produce the most exquisite displays of every tint of the spectrum.

In the distribution of color there is not apparently any advance as to differentiation over that found in the Scyphomedusæ, if indeed as much, though among the actinians certain stripings and mottlings occur over the exterior of the body. It is worthy of note that in those forms in which the tendency toward definite coloration is more evident there appears to be in many cases considerable variation of coloration. This is particularly noticeable in such forms as *Metridium* and *Cyanea.*

Face to face with this rich profusion and beauty of color what is its significance? How has it originated and what does it mean? Is it simply the expression of some original constitution peculiar to the entire class, and if so why does it differ in so marked a degree among the different subclasses? We may safely dismiss such an alternative as altogether unnecessary and without value as an explanation. May it be considered as an adaptation to protection, the result of natural selection? Certainly in no direct sense, for without exception, so far as I am aware, the more

brightly colored forms are thereby rendered correspondingly more conspicuous and, therefore, more liable to attack from enemies. May it come within the category of 'warning' coloration, due to the offensive cnidarian armor borne by most of the members of this phylum? So not a few who have essayed an account of the matter would have us believe. It seems to me, however, open to serious doubt, aside from the fact that it lacks evidence. On the other hand, among hydroids I have found that those having brighter colors are most liable to be eaten by fishes in the habit of feeding upon such a diet. Furthermore, various worms, snails, etc., which are known to feed upon them would be more likely to be attracted by colors than to be repelled. It is also matter of common observation that such animals are much more abundant among colonies of highly colored hydroids like *Eudendrium, Pennaria* and *Tubularia* than among species of *Obelia* or others of little color distinction. Many fishes with finely adapted dental apparatus are constant feeders upon corals, tranquilly browsing among the animated foliage of this luxuriant forest.

Finally, may it come within the category of 'sexual selection'? So far as I am aware, no one has ventured to assign to it any such a significance. Where sex characters are so little differentiated as among at least a portion of the phylum such an explanation would be as far-fetched as it would be unnecessary. While upon the part of some of the older naturalists there was a disposition to regard the massing of members of the Scyphomedusæ at certain times as having a sexual meaning, it may be doubted whether it has any considerable support in facts.

Concerning coloration among the anthozoa, Duerden, whose work on the group is so extended and so favorably known, has summarized the following account:

"The prevalence of the yellow and brown color is easily understood when an examination is made of the polypal tissues. For in all instances in which it occurs, the entoderm is found to be crowded with the so-called 'yellow cells' or Zooxanthellæ, which are unicellular, symbiotic algæ, the chromatophores of which are yellow or yellowish-green. That these are the main cause of the external coloration may be easily proved from colonies of *Madrepora*. In this genus the polyps toward the apex of branches are nearly colorless, and on a microscopic examination of the entodermal layer Zooxanthellæ are found to be absent while they are present in abundance in older pigmented regions."

These symbiotic algæ are not, however, the only source of color among the corals. Duerden finds ectodermal pigment granules, aggregated in somewhat irregular, isolated patches in some cases, in others somewhat regularly distributed.

He also found that a third source of coloration among corals was the presence of what he has termed 'boring algæ.' These were both red and green, and penetrate into the skeletal mass and color it a distinct red or green, as one or the other may be present.

In his work on the Actiniaria of Jamaica, this author has found in many cases the presence of unicellular green algæ growing upon the surface and giving to the polyp a distinctively green color. He found also superficial granular pigments in certain species which could be removed by any erosion of the ectoderm. I have found the same in several species of New England actinians, and in some cases the pigmentation was irregularly distributed, sometimes in blotches, sometimes in longitudinal stripes, more often the latter. So extremely variable is the coloration in many of these organisms that it is impossible to utilize it as a factor in differentiating spe-

cies. Duerden has called attention to this feature among both corals and actinians, and believes it to be due to the presence or absence of greater or less intensity of light, and believes it to be an expression of the fact that the Zooxanthellæ are not able to thrive except under proper light, and that, moreover, where light is too intense, as in shallower waters, certain dark pigment found in such specimens is thought to be due to its utility as a screen. While there may be a measure of credibility as to phases of this view, it does not seem to me as of general adequacy. The variability of species to which I have just referred and to the very common genus *Metridium* is certainly not due in any appreciable degree to the factor of light, since it occurs indiscriminately among specimens taken in identical situations as well as under those of differing conditions.

In this connection may be mentioned the same phenomenon among medusæ. The variation of coloration in *Cyanea* has long been known and is so marked that the elder Agassiz distinguished two additional species chiefly on this character, both of which have long since been discarded. It is quite well known to observers that these animals when placed in aquaria usually show within a very short time a more or less marked diminution in colors. *Dactylometra,* while living fairly well for many days in the aquarium, loses within this time so much of its usually bright coloration as not to seem like the same creature. The same is true of many other animals than medusæ. On the other hand, it is equally well known that many other animals may be placed under these more or less artificial environments with little apparent loss in this or other respect. That it is not due to light alone is evident in the fact that similar changes occur in medusæ which have been kept in open pools or enclosures about docks or elsewhere.

It seems to me rather that the true explanation is to be found in the changed conditions of nutrition and the consequent change in the metabolism of the animal. Hydroids placed under these conditions show the same tendency.

Those which take kindly to the change show no appreciable decline as to color or other vital process. The same is true of medusæ. *Gonionemus* may be kept for weeks in the aquarium, and if properly fed will show no decline in color, while if the conditions become bad an immediate change is noticeable in this as well as other features.

The same may be said concerning the actinians. While many seem to suffer noticeably when placed in aquaria others show no apparent difference. *Cerianthus membranaceus,* one of the finest of the actinians to be seen in the Naples aquarium, and one of the most variable, shows no apparent decline in any vital function. Specimens have been kept in flourishing condition in the aquarium for several years and show no sign of decline, the coloration continuing as brilliant as in the open sea. The same is true of many other organisms found in finest condition in this celebrated aquarium. Among the annelids *Protula* soon shows decline in color vigor, and the same is true, though to a less degree, in the case of *Spirographis* and *Serpula.*

While it may not be without probability that some measure of this color change may be due in certain cases to the changed conditions of light, it still remains true, I believe, that light alone is but a single factor, and that often a minor one involved in the changes observed, and that changed conditions of nutrition and metabolism are by far the more important.

The main factor of our problem, however, is still unsolved. What answer shall we make to ourselves concerning the sig-

nificance of the multiform colors more or less general among members of the cœlentera? It seems to me more or less evident that natural selection can have at best but a limited place in its explanation. I see no place for it along the lines of protection, either direct or indirect.

Of even less significance can any modification of it under the guise of sexual selection be claimed; for even aside from the large majority of cases where there is slight if any sex differentiation, no sensory organization, which Darwin recognized as essential to the exercise of this factor, is present through which it might become operative in even the smallest degree.

Two, and only two, other methods of explanation have seemed to me to afford a reasonable account. First, that it is due primarily to the normal course of metabolism, during which color appears as one of its many expressions. Darwin himself was not indifferent to this possibility, and expressly states in connection with the same problem that color might very naturally arise under such conditions. "Bearing in mind," he suggests, "how many substances closely analogous to organic compounds have been recently formed by chemists, and which exhibit the most splendid colors, it would have been a strange fact if substances similarly colored had not often originated, independently of any useful end thus gained, in the complex laboratory of the living organism." It has also been pointed out in an earlier portion of this paper that Wallace had to appeal to a similar source in his search for the primary factors of animal coloration.

Geddes and Thomson in discussing the problems of sex likewise make a similar claim. They declare, "pigments of richness and variety in related series, point to preeminent activity of chemical processes in the animals which possess them. Technically expressed, abundant pigments are expressions of intense metabolism." They further find in the phenomena of bright colors among the males of most of the higher animals simply the expression of the correspondingly greater activities of the process of metabolism.

I believe that in this source we have a real account of a considerable body of color phenomena among the lower invertebrates, and particularly of that series under present consideration.

The second factor to which I would appeal is so nearly related to the former as to be involved more or less intimately therewith. It is to the effect that certain pigments are products of waste in process of elimination. This has already been referred to in a former connection and need not be separately emphasized apart from the concrete cases to which it may be applied.

Strongly significant of the importance of this process among the Hydrozoa is the fact already pointed out that pigments are found deposited along the lines of principal metabolism, namely, the gastrovascular regions, the gonads, and to a less extent the immediate regions of sensory bodies, when these may be present. While this alone as a mere statement of fact does not prove the point at issue, when taken in connection with other facts of a similar nature, it amounts to a high degree of probability.

What evidence have we that in the case of hydroids, medusæ, etc., colors are associated with excretory processes? While the facts are not numerous, they are, I believe, rather convincing. In work upon regeneration in hydroids, Driesch and Loeb called attention to certain pigmentary matters found in *Tubularia* and

claimed for it an important function in the regenerative process. Morgan, and later Stevens, working upon the same hydroid, became convinced that the claims of the former investigators as to the importance of this pigment were not well founded. They found that not only was the pigment of no special importance, but that it was *really* a waste product, and that during the process of regeneration was actually excreted and finally ejected bodily from the hydranth. I have personally been able to confirm these results on the same and related hydroids, and have also shown that in regenerating medusæ there is formed *de novo* in each regenerating organ, such as manubrium, radial canals, etc., the characteristic pigment of the normal organ. This was particularly noticeable in the case of radial canals. Following their regeneration and promptly upon their functional activity the deposition of pigment made its appearance, and within a comparatively short time had acquired the normal intensity. This was also true of other organs, tentacles and tentacular bulbs, as well as manubrium and canals.

Substantially the same results have been obtained, though here first announced, in experiments upon one of the Scyphomedusæ. In very young specimens where the tissues are delicate it is possible to note the intense activity in regenerating organs, such as the sensory body. The first part of this organ to make its appearance is the sensory papilla, which is soon followed by the otoliths, and later by the special pigmentation of the entire organ.

From the foregoing considerations three things seem to me to be more or less evident:

1. That in all regenerative processes a very marked degree of metabolism is involved, whether in the mere metamorphosis of old tissues into new, or in the direct regeneration of new tissues by growth processes, both of which seem to occur.

2. That in regenerative processes there is often associated the development of pigmentary substances which seem to have no direct function in relation thereto.

3. That in many cases there follows a more or less active excretion and elimination of portions of the pigment in question.

Concerning color phenomena among the several classes of worms we are in much the same uncertain state of mind as in the former. For while in some of the annelids there may be found fairly well developed visual organs it may be seriously questioned whether they are of any such degree of perfection as would enable their possessors to distinguish small color distinctions. And if this be the case there would at once be eliminated any possibility of conscious adaptation in seeking a suitable environment, or such as would be involved in so-called sexual selection.

Furthermore, it is very well known that among this group some which exhibit among the richest of these color phenomena have their habitat in seclusion, buried in sand or mud, or hidden beneath stones, or with tubes built up from their own secretions, or otherwise so environed as to render practically nil the operation of natural selection.

Again, it should not be overlooked in this connection that in many of the annelids, as well as others, the most pronounced source of color is to be found in the hæmoglobin dissolved in the blood, and that it would be as futile to ascribe its color to natural selection as it would to claim a similar explanation of the color of the same substance in the blood of vertebrates, where, *as color*, it is absolutely of no selective value, except in such special cases as the colors of the cock's comb, where it may

come to play a secondary function as a sex character.

What shall be said of such forms as *Bipalium* and *Geoplana* among land planarians, which exhibit in many cases brilliant coloration, but since they are chiefly nocturnal in their habit and conceal themselves during the day under logs or other cover, the color could hardly serve any selective or adaptive function?

The same is equally true of such forms as nemerteans whose habitat is beneath the sand along the tide line or below, and also of many annelids having a similar habitat. Some of these, particularly among the latter, have types of coloration which are often of brilliant character and splendid patterns, vying, as one writer has expressed it, 'with the very butterflies.'

It can not be questioned that in some cases we find among these forms what would seem at first sight to be splendid illustrations of protective coloration. If, however, we trace in detail their distribution and variable habitat we shall often find, as did Semper in the case of *Myxicola,* that the supposed case of marvelous mimicry resolves itself into merest coincidence. This case cited by Semper is described in detail in 'Animal Life,' and its careful study by some of our over-optimistic selectionists would prove a healthy exercise, conducing to a more critical scientific spirit and, as a consequence, to saner interpretations of appearances in the light of *all* the facts.

The mimicry in the case was of coral polyps among which the annelid was found growing and which, in the form of its branches, their size and coloration, seemed so perfect that it had long escaped notice and was described by Semper as a new species.

It was found in various localities among the corals, but invariably having precisely the same simulation of the polyps, so that Semper noted it as among the finest cases of mimicry which had come to his attention. It so happened, however, that soon after he happened to discover his mimetic *Myxicola* growing upon a sponge whose color and form were so different as to render it very conspicuous. A systematic search for it in other situations soon revealed it among the rocks, and in his own language, 'Almost everywhere, and wherever I examined it carefully, it was exactly of the size and color of the polyps of *Cladocora cæspitosa.*'

Attention has already been called to Eisig's account of coloration among the Capitellidæ, in which he discards the factor of natural selection as wholly inadequate in the case of the organisms under consideration as well as in many others, and refers to many investigators who have likewise found it deficient. In his exhaustive monograph the subject is discussed in considerable detail and references given which it would be impracticable to cite in such a review as the present.

It will be possible to refer but briefly to another group or two in the present discussion, the first of which is the echinoderms, and chiefly the starfishes. As is well known, these organisms exhibit a considerable range of variety and richness of coloration, among which red, orange, brown, yellow and black are more or less common. In not a few cases of course the colors comprise combinations of two or more of those named. An examination has been made of these pigments in a few cases and has sufficed to show that for the most part they are lipochromes and, therefore, belong to either reserve or waste products. Similar colors are also found among the brittle-stars, with occasional admixtures of blue or green, colors less common in the former group.

As is also well known similar colors are found among the crustacea, into a consid-

eration of which it is impossible to enter here. There is a matter, however, which I can not ignore in connection with the group, namely, the rather remarkable fact that in two phyla having so little in common as to habit, structure or environment, there should be so striking a color resemblance. This is further heightened by the fact that while one is a prey to almost every denizen of the sea of predatory habit, the other is almost correspondingly exempt. So far as I know echinoderms have few enemies, and are of course largely invulnerable against such as might otherwise find palatable feeding among these sluggish herds. If the color is in the one case protective, why not in the other? Or if it be not protective on the other hand, why claim such in the first? That sexual selection might have some place among crustacea may not seem improbable. But if color is its signal here what does it imply among echinoderms, where in the nature of the case it must be ruled out of account?

Discussing the significance of colors among the echinoderms Mosely submits the following interesting problem: "Those coloring matters which, like those at present under consideration, absorb certain isolated areas of the visible spectrum, must be considered as more complex, *as pigments,* than those which merely absorb more or less of the ends of the spectrum. * * * It seems improbable that the eyes of other animals are more perfect as spectroscopes than our own, and hence we are at a loss for an explanation on grounds of direct benefit to the species of the existence of the peculiar complex pigments in it. That the majority of species of *Antedon* should have vivid coloring matters of a simple character, and that few or only one should be dyed by a very complex one, is a remarkable fact, and it seems only possible to say in regard to such facts that the formation of the particular pigment in the animal is accidental, *i. e.*, no more to be explained than such facts as that sulphate of copper is blue."

Considered from the standpoint of metabolism such facts would hardly seem to assume the difficulty which might be implied in the case just cited, indeed they are in perfect alignment with what might be anticipated, and what has in cases previously cited been found to be actually occurring.

Similar conditions as to color and color significance are also matters of common knowledge in relation to mollusca. Perhaps few groups among animals exhibit more brilliant and varied colors than are to be found among gasteropods, yet in many of them this factor can have no more value as a means of adaptation than do biliary pigments or hæmoglobin among vertebrates, where as pigments their significance is nil. Of them, Darwin, with his usual frankness, has said, as previously cited, 'These colors do not appear to be of any use as a protection; they are probably the direct result, as in the lowest classes, of the nature of the tissues—the patterns and the sculpture of the shell depending on its manner of growth.' Referring in the same connection to the bright and varied colors of nudibranchs, he further declares, "many brightly colored, white, or otherwise conspicuous species, do not seek concealment; whilst again some equally conspicuous species, as well as other dull colored kinds, live under stones and in dark recesses. So that with these nudibranch molluscs, color apparently does not stand in any close relation to the nature of the place which they inhabit."

Into the classic shades afforded by the insects as a fruitful haunt and stronghold of natural selection I must not venture. Not that its problems have all been solved,

nor that some considered as settled beyond controversy may not have to be readjusted, not excepting the much exploited *Kalima* itself, but out of pure regard for the exigencies of the occasion.

No more dare I presume to enter the abysses of the deep sea and to pass in review its manifold and almost untouched problems of color significance, great as is the temptation and attractive as are its inducements. It must suffice to suggest that had half the ingenuity which has been exercised to bring these problems into alignment with the general sway and supposed supremacy of natural selection been employed in an analysis of the pigments and some efforts to discover the origin of coloration and its general significance as a physiological, rather than as a physical one, we should have been saved the sad rites attending the obsequies of still-born hypotheses and half-developed theories. The desperate attempt to save natural selection from drowning in its submarine adventures by lighting its abyssal path with the flickering and fitful shimmer of phosphorescence was worthy of a better cause. It is difficult to be serious with this phase of a subject the nature of which demands anything but ridicule or satire. But the attempts to illuminate the quiescent abysses with the dull glow which under all known conditions requires, if not violent, at least vigorous stimulus to excite it, and the assumption that its sources were sufficient to meet even a moiety of the necessities involved, makes a draft upon one's credulity which might arouse either indignation or the sense of the ludicrous, depending upon the point of view! But seriously, such a conception apparently loses sight of too many evident known conditions of phosphorescence with which we are familiar, not to mention the growing belief that the phenomenon is in itself of the nature of one of the wastes of metabolism to justify the herculean attempt to make it serve a cause so desperate.

As a concluding word allow me to say that in the present review I have not in the least sought to ignore or discredit the value of natural selection as a factor in organic evolution. Nor would I be understood as wholly discarding color as a factor in organic adaptation, particularly among the higher and more specialized forms, but rather to show its limits. At the same time I must submit to a growing conviction that its importance has been largely overestimated, and that other factors have been as largely lost sight of. If the present discussion may serve in even the smallest degree to direct attention to some of the latter it will have served its chief purpose.

CHARLES W. HARGITT.
SYRACUSE UNIVERSITY.

## SCIENTIFIC BOOKS.

### THE HONEYSUCKLES.*

THIS notable addition to the literature of the genus *Lonicera* is a most welcome contribution, presenting as it does the first complete systematic treatment of the honeysuckles since their description by De Candolle in the fourth volume of his 'Prodromus,' published in 1830. Mr. Rehder has consulted the specimens preserved in all the larger American herbaria, and in the most important of those of Europe, and has consulted the living collections in the larger botanical gardens, his investigations having extended through several years. The treatment of the genus in De Candolle's 'Prodromus' recognized 53 species, of which 42 are now held to be valid; the present monograph recognizes 154 species, together with 3 imperfectly known and not named, making 157 in all, thus adding 115 species to those known in 1830. In addition to these 157 species, a large number of varieties are given rank, as also are a considerable number of forms recognized under name;

* 'Synopsis of the Genus *Lonicera*,' by Alfred Rehder (*Ann. Rep. Mo. Bot. Gard.*, **14**: 27–232, *pl. 1–20*, October 8, 1903).

some of these varieties and forms will probably come to be taken as species or subspecies, but most of them are clearly only deviations from ordinary states of the species in color or size of various organs, and the formal recognition of such things lumbers up nomenclature without any useful result.

Mr. Rehder recognizes two subgenera, *Chamæcerasus,* with four sections, and *Periclymenum,* following the division accepted by Linnæus, who united the four genera accepted by Tournefort in 1700, *Caprifolium, Periclymenum, Xylosteum* and *Chamæcerasus,* into the one genus *Lonicera,* of which it would appear that the *Lonicera Caprifolium* is to be taken as the type. Mr. Rehder remarks that the two subgenera form two very well-defined and natural groups if based on the character of the inflorescence, but he evidently does not agree to recent propositions to recognize them as genera. The genus *Distegia* of Rafinesque is only given rank as a subsection, while *Nintooa* of De Candolle is given rank as a section. Including the Mexican types, 21 North American species are recognized, no new ones being described by Mr. Rehder from within this territory in the present work; of recently described North American species, *L. sororia* of Professor Piper is reduced to *L. conjugialis* Kellogg and *L. ebractulata* of Dr. Rydberg is found to be inseparable from *L. Utahensis* S. Watson. The species which has long been called *L. ciliata* Muhl., is found to have an older name in *L. Canadensis* Marsh.; *L. villosa* Michx. is reduced to a variety of *L. cœrulea* L., following Torrey and Gray; *L. flavescens* Dippel is made a variety of *L. involucrata* (Richards) Banks; *L. Japonica* Thunb., naturalized in recent years in eastern North America from New York southward, is not uncommonly cultivated in the West Indies; *L. sempervirens* receives a new variety in var. *hirsutula* Rehder from North Carolina, but an examination of two of the specimens cited leads me to believe that this has no serious claim to recognition under name; *L. subspicata* H. and A. and *L. interrupta* Benth., reduced to varieties of *L. hispidula* by Dr. Gray, are restored by Mr. Rehder to specific rank; *L. dumosa* Gray, which has recently been regarded as synonymous with *L. albiflora* T. & G., is maintained as a variety of that species; Dr. Rydberg's recently proposed *L. glaucescens* is accorded specific rank. Only one American species known to the writer is not referred to by Mr. Rehder, being described by Dr. Small in his 'Flora of the Southeastern United States,' issued in July, 1903, viz., *Lonicera flavescens* from Tennessee and Kentucky; in naming this species, which is related to *L. Sullivantii* and to *L. flava,* Dr. Small inadvertently overlooked the older *L. flavescens* of Dippel, so that if the species holds good it will have to receive another name.

Mr. Rehder's excellent paper is illustrated by four plates of details of inflorescence and morphology and by reproduced photographs of little-known or rare Asiatic species taken from sheets in the older herbaria of Europe, largely from the collections at St. Petersburg.

Mr. Rehder records 14 doubtful species at the end of his monograph which he has been unable to refer satisfactorily, and 24 hybrids, most of which have originated in various gardens, where the parent species have been growing in proximity; none of the hybrids is indicated as of origin in the wild condition; two fossil species of the genus are known, both of them from European terranes.

N. L. Britton.

*International Catalogue of Scientific Literature.* First annual issue. O, Human Anatomy. London, Harrison & Sons. 1903 (June). Pp. xiv + 212. Price, ten shillings and sixpence.

Although the plan of this catalogue is excellent and its contents are good as far as they go, it is improbable that any anatomist who has access to Schwalbe's 'Jahresberichte ueber Anatomie und Entwicklungsgeschichte' will find it very useful. For several generations past anatomists have been accustomed to excellent year-books and a new catalogue will naturally be compared to those already in existence. The last volume of Schwalbe (1901) is a large book containing over 1,300 pages, filled with numerous abstracts, giving the titles to over 3,300 papers taken from over

650 journals. To be sure, all the papers on anatomical subjects which appeared in 1901 are not given in this volume, and there are numerous papers appearing in 1900 catalogued, but the series of volumes gives practically a complete catalogue of such papers.

When we compare the new catalogue with Schwalbe's so many deficiencies are at once seen that only a few of them can be mentioned in this review. Less than half as many titles (about 1,600) are given as in Schwalbe. To be sure, it is stated in the preface of the new catalogue that it is to be a *complete* index, but it is noted that the literature of Austria has not been included and this omission of literature is not sufficient to account for the difference between the new catalogue and Schwalbe's. The omissions are best expressed by making some comparisons. In Schwalbe's 'Jahresbericht' the blood and lymph, the female organs of sex and the integument are represented by 301, 65 and 74 titles and in the new catalogue by 77, 43 and 36 titles respectively. Under 'Pedagogy and Biography' we miss, among others, Spalteholz, 'Zum 70 Geburtstag von Wilhelm His'; Gegenbaur, 'Erlebtes und Erstrebtes'; Barker, 'On the Study of Anatomy,' and Jackson, 'A Method of Teaching Relational Anatomy'; all of which are given in Schwalbe's 'Jahresbericht.' We also do not find any reference to the *Journal of Morphology, The Biological Bulletin, The Journal of Experimental Medicine, The American Journal of Physiology, The Johns Hopkins Hospital Reports, The Bulletin of the Johns Hopkins Hospital, The American Journal of Anatomy, The Journal of Comparative Neurology, the Proceedings of the Association of American Anatomists* and the *Journal of Medical Research,* each of which contains articles on anatomy—83 altogether. In the new catalogue we find but one reference to Minot and one to Bardeen; in Schwalbe there are eleven references to these two authors.

While there are many omissions there are also many duplications. Spalteholz's 'Atlas' with its translation is entered thirteen times; Szymonowicz, which came out in parts is given fifteen times, while Stöhr is given six times in the subject catalogue and not at all in the authors' catalogue. There are also a number of contributions which should not have been included in this catalogue, *e. g.,* Meisenheimer, 'Die Entwicklung von Herz, Perikard, Niere und Genitalzellen bei *Cyclas,*' etc., and also a few subjects catalogued under the wrong headings. Eisler on the 'Muscularis Sternalis' should be under 'Abnormalities' and Parskij, 'Die Anatomie und Histologie der Schildrüse,' should not be under 'Pituitary Body.'

The above illustrations are only a few, but they are sufficient to show that the 'International Catalogue of Scientific Literature on Human Anatomy' is very incomplete; so much so, that anatomists will not find in it a substitute nor a supplement to the lists accompanying the *Anatomischer Anzeiger* nor to Schwalbe's 'Jahresbericht.' It is to be hoped that the volume for 1902 will include all the titles found in any of the lists, for they are at hand and can be copied and supplemented. A *complete* authors' catalogue with a subject catalogue will be welcomed by all anatomists.

M.

## SCIENTIFIC JOURNALS AND ARTICLES.

WE have received the first number of the *Journal of Philosophy, Psychology and Scientific Methods,* edited by Professor Frederick J. E. Woodbridge, of Columbia University and published by The Science Press (Sub-station 84, New York City). The contents are as follows: 'The International Congress of Arts and Science,' Professor Hugo Münsterberg; 'The Religious Consciousness as Ontological,' Professor George Trumbull Ladd; 'Some Points in Minor Logic,' Christine Ladd Franklin; 'The Third Meeting of the American Philosophical Association'; 'Stratton's Experimental Psychology,' Professor H. Austin Aikens; 'Journals and New Books'; 'Notes.' The scope of the journal is explained in an editorial note which reads: "In so far as an explanation or even an excuse may be needed for the establishment of a new journal, it is hoped that this may be given by the contents and form of the first number of *The Journal of Philosophy, Psychology and Scientific Methods.* There are in

Germany 'Centralblätter' for nearly all the sciences, and there are in all countries 'trade journals' for the applied sciences such as medicine and engineering. But there exists no journal covering the whole field of scientific philosophy, psychology, ethics and logic, appearing at frequent intervals and appealing directly to the interests of all professional students. It is a matter of importance at the present time that the relations between philosophy and psychology should remain intimate, and that the fundamental methods and concepts of the special sciences, now receiving attention on all sides, should be kept in touch with philosophy in its historic development. What may be accomplished by the prompt publication of short contributions is demonstrated by the *Comptes Rendus* of the Paris Academy, whose four-page articles cover nearly the whole scientific activity of France. A fortnightly journal is particularly suited for discussion, the interval being just long enough to permit of questions and answers. Finally the special function of such a journal is the quick and complete publication of reviews and abstracts of the literature."

*The Botanical Gazette* for December contains the following articles: E. N. Transeau, in a paper 'On the Geographic Distribution and Ecological Relation of the Bog Plant Societies of Northern North America,' finds that the bog plant societies of North America show an optimum dispersal in moist climates subject to great temperature extremes. Relations of the bog societies are with the conifer rather than with the deciduous forests. The bog societies are considered as relicts of former widespread societies, and are observed in various places largely because of favorable temperature conditions. Edward W. Berry discusses '*Aralia* in American Paleobotany,' giving a critical account of the fossil forms that have been referred to this genus.—In his concluding instalment of 'The Vegetation of the Bay of Fundy Salt and Diked Marshes: an Ecological Study,' Professor Ganong considers the mesophytic and hydrophytic conditions of the Bay of Fundy marshes, also the succession of plants in place and time. In his conclusion he makes an earnest appeal for more careful description of ecological facts, longer periods of study before publication, and advance in the method of correlating meteorological data with vegetation, the recognition of physiological as well as structural adaptations, and a careful study of the exact nature of plant cooperation and competition.—Alice Eastwood publishes a synopsis of *Garrya,* a characteristic California genus, and describes three new species.—J. Y. Bergen, in a study of 'The Transpiration of *Spartina junceum* and other Xerophytic Shrubs,' has reached the conclusion that during the leafy season the relative power of transpiration of the leaves compared with that of the cortex is much greater for equal areas, and that leafless individuals of *Spartina* grow but little in any season.

## *SOCIETIES AND ACADEMIES.*

### THE SAN FRANCISCO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

The fourth regular meeting of the San Francisco Section of the American Mathematical Society was held at the University of California on December 19, 1903. Fourteen members of the society were present. A number of other teachers of mathematics living in or near San Francisco attended both of the sessions. The following officers were elected for the ensuing year:

*Chairman*—Professor Allardice.
*Secretary*—Professor Miller.
*Program Committee*—Professors Haskell, Stringham and Miller.

The dates of the regular meetings of the section were changed from May and December to February and September. This change is to go into effect after the next regular meeting, which will be held at Stanford University in May. The following papers were read:

Dr. E. M. Blake: 'Exhibition of models of polyhedra bounded by regular polygons.'

Professor M. W. Haskell: 'Brianchon hexagons in space.'

Professor R. E. Allardice: 'On the locus of the foci of a system of similar conics through three points.'

Professor Irving Stringham: 'On curvature in absolute space.'

PROFESSOR H. F. BLICHFELDT: 'On the order of linear homogeneous groups II.'

PROFESSOR E. J. WILCZYNSKI: 'Studies in the general theory of surfaces.'

PROFESSOR E. J. WILCZYNSKI: 'A fundamental theorem in the theory of ruled surfaces.'

PROFESSOR G. A. MILLER: 'On the roots of group operators.'

DR. D. N. LEHMER: 'On the Jacobian curve of three quadric surfaces and a certain ruled surface connected with it.'

DR. D. N. LEHMER: 'On a new method of finding factors of numbers.'

MR. W. A. MANNING: 'On the primitive groups of classes six and eight.'

PROFESSOR M. W. HASKELL: 'Approximations to the square root of positive numbers.'

In the absence of their authors, Dr. Blake's models were explained by Professor Haskell, Professor Wilczynski's papers were presented by Dr. Lehmer, and Mr. Manning's paper was read by the secretary.

G. A. MILLER,
*Secretary*.

### ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 352d meeting was held December 15, 1903. The committee on the preservation of ancient monuments reported a form of petition to congress which might be sent out for signatures. The report was accepted, the committee continued and instructed to give publicity to the petition, and they were authorized to frame a bill on the lines of the petition.

Mr. W. H. Babcock communicated to the society a letter from Mr. J. E. Betts on the aborigines of China called Changkia and Miao.

The paper of the evening was by Dr. George Byron Gordon, of Philadelphia, on the subject, 'The Ruins of Copan.'

Doctor Gordon traced the limits of the Maya and Aztec peoples, and said that they sprung from a stem whose origin and location is wrapped in mystery. Views of the elaborately carved monoliths of Quirigua were thrown on the screen and Doctor Gordon said that those showing bas reliefs of men are placed to the north and those of women to the south of a given line through the ruins. No metals were found here and few stone tools, but the sculpture was worked out with stone implements. The phases of art displayed in the monoliths were discussed and it was pointed out that the dragon-like carvings of serpents represent the rattlesnake, the spots on the back being transferred to the side in the carving. Views of the sculptures, the ruins and surroundings of Copan were next presented and discussed. One of the pyramids has been partly cut away by a stream, and in the section are a number of successive pavements and sewers, giving evidence of considerable antiquity to the structures.

Dr. H. M. Baum asked whether the present Mayas are descendants of the people who made the buildings. Doctor Gordon replied that none of the tribes know anything about them so far as any one has been able to discover.

Doctor Fewkes said that the Pueblo Indians call the north, male; the east, female; the south, male; and the west, female. The great plumed serpent of the Pueblo mythology is also related to the serpent of Central America. Doctor Fewkes believes that the different cities of Copan carry back man on this continent a long period.

Doctor Hrdlicka said, in reference to the buried cities of Copan exposed in the section of a pyramid, that the work may represent different periods of advancement of the structure rather than different ages.

At the close of the meeting a vote of thanks of the society was given to Doctor Gordon for his interesting paper.

WALTER HOUGH.

### THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

A MEETING of the club was held on November 17, when two papers were presented by Professor Augustus Trowbridge, as follows: (*a*) 'Personal Reminiscence in an Italian University.' This paper was illustrated with lantern slides and dealt with the lecturer's experiences while recently traveling in Italy. (*b*) 'New Experiments in Wireless Telegraphy,' was a description of some recent original devices got up by the lecturer for receiving wireless messages. The paper was illustrated, and wireless messages were received in the lecture room during the lecture.

VICTOR LENHER,
*Secretary*.

## DISCUSSION AND CORRESPONDENCE.

### THE LUNAR THEORY.

In a recent number of the *Monthly Notices* of the Royal Astronomical Society, Mr. P. H. Cowell gives an account of his investigations on the motion of the moon. He finds considerable errors in Airy's theory, but gives no explanation of the small defect in the tables of Hansen. A curious result of several investigations is to show the accuracy of the tables of Damoiseau, made four score years ago, and after a theory which has gone out of use.

The interest now shown in the lunar theory by several astronomers promises to give us better tables of the moon. Two methods can be followed. The attractive one is to make a new theory, since in this case one has the entire question in hand. But this requires a great expenditure of labor. The other method would be to correct the tables of Hansen. The accuracy of the coefficients in these tables is very great, and it is a pity so much good work should be lost. In determining the orbit of the moon for the formation of his tables Hansen introduced twelve unknown quantities into his equations of condition, or fourteen, if we include the two depending on the distance from the center of figure to the center of gravity of the moon. It is not much wonder that a small error should have been committed in such a complicated theory. The manuscript of Hansen must be preserved, probably in the observatory of Gotha, where he spent most of his life. There are several astronomers in Germany who studied with Hansen, and who understand his methods. It is to be hoped that a careful revision of Hansen's calculations on this theory will be made and that his error may be discovered.

After looking at some of the works on this theory I venture to make this suggestion: that astronomers should unite on a system of notation for the lunar theory. So many changes have been made that it is almost necessary to have a dictionary of symbols in order to read the various memoirs.

A. Hall.

Norfolk, Conn.,
January 5, 1904.

### THE SCAURS ON THE RIVER ROUGE.

To the Editor of Science: The earth's rotation causes in the winds of our hemisphere a tendency to deviate to the right of straight ahead in whatever direction they are flowing (Davis' 'Meteorology,' p. 101). It ought to produce the same effect on rivers (Russell, 'Rivers of North America,' p. 41). Instances have been supposed to be found in the streams on the south coast of Long Island (*American Journal of Science,* 1884, p. 427), in the great detrital cone of Lannemezan, on the Rhine, Danube, Ob, Irtish, Nile, New Zealand streams, Parana and Paraguay by authors cited in Penck, 'Morphologie der Erdoberfläche,' pp. 351–360. From objections that have been made to most of these illustrations it appears that there is more of unanimity as to the theory than in the conviction aroused by the evidence offered.

The Michigan rivers have long seemed to me suitable to examine for evidence of this sort. They are young, meandering streams, not usually encountering ledges, but flowing either in lake clays or in a till that has few large boulders and is fairly homogeneous.

The Rouge is a stream some twenty-five miles long that flows into the Detroit River a few miles west of Detroit. At Dearborn two forks of the river unite into one. Early in November I visited the west branch in company with Mr. Isaiah Bowman to look over the availability of the valley for work with my class in field geography. The river is ten or fifteen feet wide, meandering on a flood plain two or three hundred feet wide, which is incised in the level clays that once formed the floor of Lake Maumee. Every now and then the stream in its meandering undercuts the bank, causing a naked bluff of clay in a landscape that is elsewhere well grassed. Such a bluff is what the Scotch call a scaur. As the scaurs indicated the points where the river is actually at work widening its valley, it was proposed to measure the proportion of bank occupied by them. To this end we paced the distance along the river bank under each scaur and by the flood plain to the next one, noting whether the scaur was on the right bank or

the left. The results are given in the following table.

First Day.

| Scaur. Right. | Scaur. Left. | Flood Plain. |
|---|---|---|
| 222 | | 245 |
| | 55 | 187 |
| | 73 | 350 |
| 96 | | 271 |
| | 90 | 442 |
| 73 | | 303 |
| | 21 | 518 |
| | 34 | 273 |
| 41 | | 287 |
| 76 | | 236 |
| 50 | | 280 |
| | 31 | 100 |
| | 53 | 466 |
| 95 | | 168 |
| 653 | 357 | 4,126 |

| | |
|---|---|
| In all | 5,136 |
| Total both banks | 10,272 |
| Total scaur | 1,010 |
| Per cent. of scaur | 10 |
| Per cent. of scaur on right | 64 |

Second Day.

| Scaur. Right. | Scaur. Left. | Flood Plain. |
|---|---|---|
| | 66 | 295 |
| 56 | | 300 |
| | 130 | 273 |
| 120 | | 153 |
| 173 | | 225 |
| | 195 | 1,160 |
| | 39 | 144 |
| 30 | | 350 |
| | 60 | 245 |
| 16 | | 341 |
| 178 | | 256 |
| | 47 | 196 |
| | 37 | 100 |
| 200 | | 343 |
| 48 | | 260 |
| 100 | | 1,218 |
| 27 | | 78 |
| 30 | | 30 |
| | 17 | 259 |
| | | 180 |
| 978 | 591 | 6,406 |

| | |
|---|---|
| Total | 7,975 |
| Total both banks | 15,950 |
| Total scaur | 1,569 |
| Per cent. of scaur | 10 |
| Per cent. of scaur on right | 62 |

Mr. Bowman's pacing gave practically the same results.

As my pace is 2.75 feet, we walked the first day 2.6 miles and the second 4.1, and found each time that along one tenth of its course the Rouge is widening its valley, while two thirds of this work is being done on the right bank. This called Mr. Bowman's attention at once and he will prosecute further studies on this and other streams. Of course, the interest here is in a possible criterion for detecting deflection of rivers by the effect of the earth's rotation. The distance is short, yet the results are singularly uniform, as appears from the following analysis in detail.

Grouping the scaurs by successive amounts of about 500 paces, we have:

| Total Scaur. | Right. | Left. | Percentage on Right. |
|---|---|---|---|
| 536 | 318 | 218 | 59 |
| 474 | 335 | 139 | 71 |
| 545 | 349 | 196 | 64 |
| 518 | 224 | 294 | 43 |
| 506 | 405 | 101 | 80 |
| 2,579 | 1,631 | 948 | 64 |

Rivers ought to show the effect of the earth's rotation and no criterion could be simpler in theory or application than this. As the Rouge flows fairly to the east prevalent westerly winds urge the river neither to right nor left.

Mark S. W. Jefferson.
Michigan State Normal College,
December 7, 1903.

## SHORTER ARTICLES.

### WONDER HORSES AND MENDELISM.

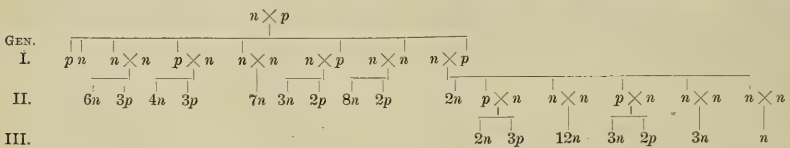
Dr. Castle's reference to the Oregon Wonder horse in Science for December 11 reminds me that in the autumn of 1899 I corresponded with Mr. James K. Rutherford, of Waddington, N. Y., who then owned a horse called Linus II. Mr. Rutherford sent a photograph of the horse, taken in 1898. The photograph shows a Morgan horse probably about five years old with a double mane which trails on the ground on either side for a distance of two feet. The tail trails on the ground for a distance of about six to eight feet. Correspondence with Mr. Rutherford yielded the following additional statements: Linus II. is the son of Linus I., which had a mane that was single, but at fourteen years old eighteen feet long, while the tail was twenty-one feet long. "The mother also had a remarkable growth of hair." The paternal grandmother was known as the 'Oregon Beauty' and was noted for the mass and length of her hair. My correspondence with the owner of Linus I. led to few additional facts. He stated that the long

hair had been in the family since importation [to Oregon(?)] and added: 'the growth and quantity has increased with each generation.'

It will be seen that the data are somewhat inconclusive. Had the father as well as the mother of Linus I. been long-haired (recessive, according to Dr. Castle's hypothesis), then we can understand the long hair of Linus I. The latter was mated with a recessive (?) mare (if 'remarkable growth of hair' may be so interpreted) and produced Linus II.

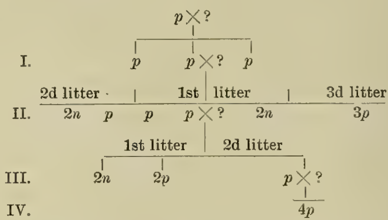
On the whole, it would seem more probable that the long-haired property was dominant, unless, indeed, Linus II. got no long-haired progeny. The data are, as we see, insufficient to decide the matter.

The question of the Mendelian behavior of animal mutations has long interested me and I have collected some statistics bearing on the subject. The records concerning polydactylism are, perhaps, the most complete and instructive. In the *Jenaische Zeitschrift*, XXII., Fackenheim, 1888, has given a table that may be thus summarized: Each letter $n$ (normal) or $p$ (polydactyl) stands for a person, the coefficient being used to indicate the number of such persons in a family.




On the assumption that polydactylism ($p$) is dominant and the normal condition ($n$) is recessive, any $p$ of unknown ancestry may be a $(D+R)$. Then the offspring of the parents $R \times (D+R)$ might give $(DR)+(RR)$ or an equal proportion of $p$ and $n$. There are 4 $p$ and 4 $n$ in the first filial generation; thus agreeing with theory. Of the $p$ offspring of this first filial generation one third should be pure $D+D$ and should produce only polydactyl children even with normal consorts. This condition is not realized, for both of the polydactyls of whose offspring we have a record produced both $n$ and $p$ offspring; but this is not surprising, considering that there are only *two* cases. The majority of the $p$ offspring should produce $p$ and $n$ in equal numbers in the second filial generation—we get 7 $p$ and 12 $n$ in generation III. and 5 $p$ and 5 $n$ in generation IV. or 12 $p$ and 17 $n$ altogether, which is a wide but not unlikely disagreement from theory. Of the $n$ children mated with $n$ consorts, theory would demand that *all* should be $n$, since $R \times R$ gives only $R$ qualities. In the second filial generation this happens in one family of seven children, but does not happen in two families with a total of 19 children in which 5 $p$'s occur. The total of the three families is 21 $n$ and 5 $p$. This is not Mendelism, but there is certainly a marvelous prepotency of the normal quality. In the third filial question from three $n \times n$ families all of the 16 children are $n$. If we had this generation only we should certainly have a right to suspect that $n$ is truly recessive.

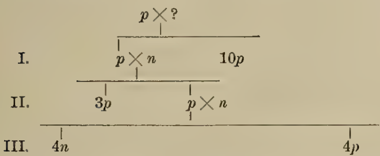
Consider next the records of polydactyl cats given by Poulton, 1883, in *Nature*. The fathers are not known, but Poulton says it is highly improbable that an abnormal female has ever crossed with a likewise abnormal male.




This case is easily explained on Mendelian principles, for assuming $p$ to be dominant and the mother in the first filial generation to have $(D+R)$ gametes, then there should be out of 10 offspring 5 $p$ and 5 $n$; there are 6 $p$ and

4 $n$. The third generation accords with the assumption that the $p$ parent has $(D+R)$ gametes, while the $p$ parent in the third generation behaves as would one that had purely dominant gametes. Unfortunately, the record stops here.

Struthers has given the following case of polydactylism in man:

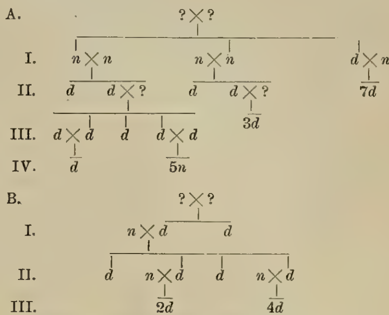



This result can be explained on the Mendelian hypothesis by considering the original parent to have only $D$ gametes; and that the father was also polydactyl. The offspring (I.) are all $p$ and purely dominant. In the first filial generation $D$ is crossed with $R$ and the dominant offspring have $(D+R)$ gametes; when one of these gametes of the second filial generation is crossed by $R$ the product is $DR + RR$ (third generation). We should expect an equal number of dominant and recessive individuals and we get them. If, on the other hand, we calculate the proportion of abnormal individuals in accordance with Galton's Law we should get only 33 per cent. instead of the actual 50 per cent. Mendel's Law here accords with the facts better than Galton's Law.

These relations and the remaining descendants are given in the accompanying diagram.

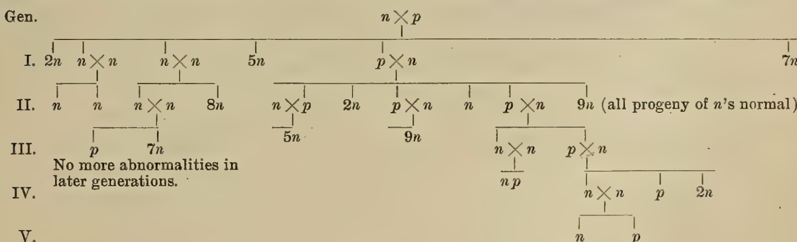
This case differs from the preceding in the small proportion of $p$'s occurring in any generation. These small percentages can hardly accord with Mendel's Law.

Finally, we may consider some cases of inheritance of deaf-mutism for records of which we are indebted to Bell, 1884, *Mem. National Academy of Sciences*, II., pp. 179 and 208.




It seems impossible to regard either $n$ or $d$ as recessive. If $n$ is recessive how can $d$ be derived from two $n$ parents as in Case A, Gen. I.? If $d$ is recessive, how can 5 $n$ come from two $d$ parents as in A, Gen. III.?

The conclusion of this communication is that while Mendelian principles seem applicable to some cases of crosses between sports and the normal species, there seem to be others where neither Mendel's nor Galton's Law of Inheritance holds.




Another series is given by Struthers (1863) in the *Edinburgh New Philosophical Journal* for July. Mr. A. L., normal, married E. P., who had six fingers on the left hand. They had eighteen children, of whom one only was abnormal, with six fingers on both hands.

C. B. DAVENPORT.
HULL ZOOLOGICAL LABORATORY,
UNIVERSITY OF CHICAGO.

THE INHERITANCE OF SONG IN PASSERINE BIRDS. REMARKS AND OBSERVATIONS ON THE SONG OF HAND-REARED BOBOLINKS AND RED-WINGED BLACKBIRDS (DOLICHONYX ORYZIVORUS AND AGELAIUS PHŒNICEUS).

During the past spring (1903) I secured a brood of bobolinks and two broods of red-winged blackbirds. These young nestlings were carefully reared, and, while allowed to hear many other kinds of birds sing, were not placed where it was believed that they could hear the songs of their own species. The results about to be described have been based on continuous observation, in the case of the blackbirds for six weeks, and for the bobolinks three weeks. Care has been taken to have competent judges, well acquainted with the song of both species, listen to the song of these birds without seeing the singers. In no instance was the song recognized; one listener ascribed the song of two red-winged blackbirds to the brown thrasher (*Toxostoma rufum*), and was wholly unable to form an opinion as to what birds were singing when listening to the performance of two bobolinks. It should be stated that there were but two males of each of the species in question from the broods that had been reared.

The song of the bobolinks is loud and brilliant as well as sustained; that of the red-winged blackbirds is even of greater volume and may be best described as continuous.

A word seems essential as to the call-notes of the two kinds of birds in question. I have failed to distinguish anything that resembles the call-note of the bobolink in its wild state, nor any sound that emanates from the two representatives of this species that are under observation which could be referred to bobolinks in a wild state. The interval of the notes and the duration of the song seem, however, not unlike those of wild bobolinks. One of the young birds, moreover, has been noticed both by myself and other observers attempting with a marked degree of success to sing the continuous rolling warble with its rising and falling inflection that characterizes the Hartz Mountain roller canary.

The call-note of the red-wing blackbird is clearly distinguishable in the two red-wing blackbirds under observation, but is the only sound that might be referred to that species. The song of these two birds seems to be made up of a composite jumble wherein robin and thrush-like notes of great clearness and volume predominate. The duration of the song is not marked by any particular break, the performance generally lasting from five to ten minutes. The clear robin and thrush-like notes are connected by fainter warbles and lisps, the whole being continuous.

The blackbirds were taken during the first weeks in June and were probably about a week old. They began to sing early in September, and the only interruption was an interval of four or five days when they changed from the liberty of a room where they could fly about to two large room cages.

The bobolinks were taken on the twelfth day of June and were much younger than the blackbirds, being not more than four days old. They have been kept all the time together in a large cage, and have not known the freedom of a flying room. They began to sing about the first of November, and in a few days could be heard in song at almost any time during daylight.

William E. D. Scott.

Princeton, N. J.,
November 30, 1903.

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*THE U. S. NAVAL OBSERVATORY.**

The astronomical force has been gradually diminished year by year, first by the detachment of a number of line officers who were formerly assigned positions as observers, and more recently by the detachment of several professors of mathematics for duty at the Naval Academy. This not only left the observatory short-handed, but made frequent rearrangements of the personnel necessary. Each new assignment to astronomical duty retards the work, breaks up its continuity, and diminishes the output. It is such changes as these among subordinate officers who have special work to do that pro-

* From the reports of the Superintendent Rear-Admiral C. M. Chester, for the year ending June 30, 1903.

duce confusion, as in the case of every other executive branch of the government; not, as is frequently maintained, the change of the head or administrative officer. He must necessarily continue the policy left by his predecessor until experience has demonstrated the wisdom of innovations.

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In addition to the drawback to efficient administration and labor caused by the reorganization of the personnel, most of the time of the superintendent and staff during the latter half of the year has been given up to answering questions called forth by several investigating boards. These boards have consisted of:

1. A board ordered by the Navy Department, composed of Rear-Admiral F. M. Ramsay, U. S. Navy; Capt. J. E. Pillsbury, U. S. Navy; and Commander C. J. Badger, U. S. Navy; 'for the purpose of inquiring into and reporting upon the advisability of eliminating or transferring to other than the control of the Navy Department any of the work now performed at the Naval Observatory.'

This board reported that 'in the opinion of the board, the regular work of the Naval Observatory is essential to the Navy; it can be systematically and successfully accomplished only under government control; and no portion of it should be discontinued or transferred to other than the control of the Navy Department.'

2. The General Board of the Navy, of which Admiral of the Navy George Dewey is president, to which was referred the same subject that was referred to the preceding board, rendered a similar decision.

3. A committee ordered by the President of the United States, composed of Mr. Charles D. Walcott, chairman; Brig. Gen. William Crozier, U. S. Army; Rear-Admiral Francis T. Bowles, U. S. Navy; Mr. Gifford Pinchot and Mr. James R. Garfield, to report upon various matters connected with the organization of the government scientific work. The report of this committee has not yet been made public, but it also thoroughly investigated the Naval Observatory.

Added to the drain on the time of the astronomical staff incident to the above-enumerated conditions is that due to the greatly increased demand for navigational instruments for the numerous ships building for the Navy. No small portion of the labor due to this demand has fallen on the Naval Observatory. Formerly from four to six naval line officers were employed in the three departments of nautical instruments, storekeeper and chronometers and time service. Now one lieutenant-commander is the only line officer detailed for the combined duties of all three departments. Other branches of the naval service have been supplied with additional men paid from the general appropriation 'Increase of the Navy' to meet these conditions, but the requirements of this observatory seem to have been overlooked.

Failing to procure the needed force for this important service, it has been necessary, under the Bureau of Equipment's general order to sacrifice astronomy for military duties, to assign two computers from the astronomical force to keep up with the extraordinary demands of the fleet. Further than this, as is shown in the report of the head of the department of nautical instruments, articles of equipment for naval vessels are such that the board of inspection which passes upon invoices before they are paid for must devote much time to the examination of each article, and thus not only has the fleet made an unusual number of calls on the observatory staff, but each call has required a greater amount of time than is usual at other naval stations. It should be remembered that navigational intruments can not be passed over with the cursory inspection given to ordinary supplies for a ship, but must be subjected to a critical test of all their different parts under varying conditions, needing at times several hours to pass one item of a schedule. As the one line officer at the observatory can not report upon the articles under his charge, professors of mathematics who are employed for astronomical work have been detailed to act on the board of inspection, thereby detracting from their own individual work.

Feeling as I do that the work of the Naval

Observatory has been greatly handicapped by the conditions briefly outlined above, I commend to the department the zeal of the staff as worthy of more consideration than seems to have been accorded it in the past. The members of the staff have vied with each other during the past year in doing more than was required of them, and thus have been enabled to maintain a good average of records; but such conditions can not be expected to continue. In one instance a member of the Nautical Almanac Department, Mr. H. B. Evans, in addition to a full-time service in that department, has devoted a good part of three nights in the week to observational astronomy, giving to the records data of much value. Also, Mr. Hammond, a member of the computing division of the observatory, has contributed overtime work in the search for and location of asteroids, a work that has been much appreciated by outside astronomers.

Such observations have been published in astronomical periodicals and the authors given credit for their work, thus making an incentive for additional labor.

While such work may be only incidental to naval purposes, it helps to maintain the interest of observers in a class of astronomy that is more or less a drudgery and carries out the precept of the observatory to contribute to astronomical science. It also produces better results in routine observations.

## *SCIENTIFIC NOTES AND NEWS.*

The French minister of public instruction and fine arts has conferred the degree of officer of public instruction upon Dr. Lester F. Ward for his scientific and sociological works. This highest degree of the academic order is usually only conferred on persons who have for five years held the degree of officer of the academy.

Dr. W. Roux, professor of anatomy at Halle, has been elected a foreign member of the Brussels Academy of Sciences.

Professor H. De Vries, of Amsterdam, and Professor R. von Wettstein, of Vienna, have been elected honorary members of the Berlin Botanical Society.

Grants in aid of research have recently been made from the Rumford Fund of the American Academy of Arts and Sciences as follows: to Professor Edward W. Morley, for his research on the nature and effects of ether drift, \$500; to Professor Carl Barus, for his research on the study by an optical method of radio-actively produced condensation, \$200; to Mr. J. A. Dunne, for his research on fluctuations in solar activity as evinced by changes in the difference between maximum and minimum temperature, \$200.

President Roosevelt has appointed the assay commission for 1904, which will test the weight and fineness of coins produced at the mints of the United States during the year. The members include Dr. S. W. Stratton, chief of the Bureau of Standards; Mr. Marcus Benjamin, of the Smithsonian Institution; Professor Edgar F. Smith, of the University of Pennsylvania, and Professor William Hallock, of Columbia University.

Mr. J. A. Ewing, F.R.S., lately professor of mechanism and applied mechanics, Cambridge, and Mr. Karl Pearson, F.R.S., professor of applied mathematics in University College, London, and formerly fellow, have been elected to honorary fellowships at King's College, Cambridge.

The silver medal of the Munich Academy of Sciences has been conferred on Professor Rudel, of Nüremberg, for his researches in climatology.

Dr. W. T. Blanford, F.R.S., who was on the staff of the Geological Survey of India from 1855 to 1872, has been made a Companion of the Order of the Indian Empire.

Mr. R. G. Carruthers and Mr. G. W. Grabham have been appointed geologists on the British Geological Survey.

Brigadier-General A. W. Greely, chief signal officer of the U. S. Army, has refused to go on the retired list with the rank of major-general, preferring to remain in active service.

Dr. T. D. Wood, professor of physical education in Teachers College, Columbia University, has been given leave of absence for the rest of the year on account of his health.

PROFESSOR E. B. VOORHEES, of Rutgers College, has been appointed president of the New Jersey State Board of Agriculture.

MR. OTTO E. JENNINGS has been appointed custodian of botanical collections at the Carnegie Museum, Pittsburg, Pa. Mr. Jennings has been Professor Kellerman's herbarium assistant for two years in the Ohio State University.

DR. E. W. OLIVE, who has been studying for the past year some nuclear problems of certain lower plants in the laboratory of Professor Strasburger, has received another grant from the Carnegie Institution and will continue his work in the laboratory of Professor Harper, at Madison.

PROFESSOR VERNON F. MARSTERS, of the department of geology in the University of Indiana, is spending a year's leave of absence at Columbia University, pursuing work in geology and anthropology.

MR. GEORGE T. HASTINGS, a graduate of Cornell University and assistant in botany in that university in 1899–'00, recently returned from Santiago, Chili, where for two years he has been teacher of science in the English Institute. Mr. Hastings made a good collection of plants from central Chili during his stay there and is now preparing sets for distribution to herbaria. He is doing this work in the botanical department at Cornell.

PROFESSOR BLANCHARD, of Paris, accompanied by Dr. R. Wurtz, professor in the medical faculty of the University of Paris, and twelve students of the Paris Institut de Médecine Coloniale, paid a visit to the London School of Tropical Medicine on December 28.

As we have already stated, Dr. Hans Gadow, F.R.S., lecturer on zoology in the University of Cambridge, is coming to America at the end of March for the purpose of giving six lectures on 'The Coloration of Amphibia and Reptiles,' specially prepared for the Lowell Institute in Boston. He desires to secure engagements for lectures in other institutions. Communications regarding engagements for lectures may be sent directly to Dr. Gadow at the University Museum of Zoology, in Cambridge, or, after March 15, in care of Professor W. T. Sedgwick, Massachusetts Institute of Technology, Boston.

IT is expected that Dr. Alexander Graham Bell, bringing the remains of James Smithson on the steamship *Princess Irene*, will arrive in New York this week. It is planned that the *Dolphin*, of the U. S. Navy, will meet the steamship and carry the remains of Smithson to Washington.

THE District of Columbia Library Association has held a meeting in memory of the late Henry Carrington Bolton and Marcus Baker. Professor F. W. Clarke made the principal address on Dr. Bolton, and Dr. W. H. Dall, the principal address on Mr. Baker.

THE Max Müller Memorial Fund, which is to be held in trust by the University of Oxford for the promotion of learning and research in the history, archeology, languages, literature and religion of ancient India, now amounts to about $12,000.

IT is proposed to erect at Rome a memorial to the eminent mathematician, Luigi Cremona, and it is hoped that the contributions will be international in character. Subscriptions should be sent to Signor I. Sonzogno, Piazza San Pietro in Vincoli, 5, Rome.

THE death is announced of Miss Anna Winlock, of the Harvard College Observatory. She was the daughter of Professor Joseph Winlock, superintendent of the Nautical Almanac, and later, until his death in 1875, director of the Harvard College Observatory. At this time Miss Winlock entered the observatory as a computer and subsequently assisted in the preparation of a large number of important papers issued from the observatory.

THE death is announced of the eminent professor of psychiatry and nervous diseases in the University of Berlin, Dr. Friedrich Jolly. Professor Jolly, who was born at Heidelberg in 1844, occupied professorial chairs at Würzburg and at Strasburg before he was called to Berlin in 1890. We regret also to record the deaths of M. Jean Dufour, professor of plant physiology at Lausanne at the age of forty-three years; of Dr. A. Edmund Hess, professor of mathematics at Marburg, at the age of sixty years; of Dr. Sophus Ruger, professor

of geography and anthropology at the Technical Institute of Dresden, at the age of seventy-two years, and of Dr. Sophie Perejaszlawzena, formerly head of the Zoological Station at Sebastopol.

A cablegram to the New York *Times* states that by the will of the late Herbert Spencer all rights and property in his books and investments are given to the trustees, the Hon. Auberon Herbert, Dr. Henry Charlton Bastian and David Duncan, with instructions to employ the yearly revenue "in resuming and continuing during such period as may be needed for fulfilling my express wishes, but not exceeding the lifetime of all descendants of Queen Victoria who shall be living at my decease and of the survivors and survivor of them, and for twenty-one years after the death of such survivor, the publication of the existing parts of my 'Descriptive Sociology,' and the compilation and publication of the fresh parts thereof upon the plan followed in the parts already published." Afterward all copyrights, stereotype plates, etc., are to be auctioned and the proceeds divided among a number of scientific societies. The will orders that Spencer's autobiography is to be published simultaneously in Great Britain and the United States, and requests David Duncan to write a biography in one volume of moderate size.

The Linnean Society of New South Wales has received about $170,000 from the late Sir William Macleay for the endowment of research fellowships in science.

We learn from *Nature* that a meeting was held in the house of the Zoological Society on January 5 to consider proposals for the organization of zoologists. Forty-one zoologists from England, Scotland and Ireland attended the meeting. The following resolution was carried by a large majority: "That it is desirable that the zoologists of Great Britain and Ireland be organized for the consideration of all matters affecting the interests of zoology and zoologists, and to take such action as may seem desirable." A committee consisting of Professor Cossar Ewart, Professor Bridge, Professor Hickson, Dr. Scharff, Dr. G. C. Bourne, Dr. Ridewood and Mr. Cunningham was appointed to draw up a scheme.

Baron Erland Nordenskjöld's expedition to Peru and Bolivia is expected to arrive about February 15 at La Paz, the capital of Bolivia, which will be the departing point for the expedition to Lake Titicaca.

Owing to a fire in a printing house in New York City the electrotype plates and matter in type of several volumes of the *Transactions* of the American Institute of Eletrical Engineers have been destroyed.

*Nature* states that the Brothers Kearton have arranged to hold an exhibition of enlarged photographs of birds, beasts, reptiles and insects at the Modern Gallery, London, on January 2–12, 1904, inclusive. The gallery will be open from 10 a.m. until 9 p.m., and Mr. R. Kearton will deliver lime-light lectures to children each afternoon, and to adults in the evening.

We learn from the London *Times* that Mr. James G. Ferrier, secretary of the Scottish Antarctic Expedition, has received from Mr. W. S. Bruce, the leader of the expedition, narratives of the voyage of the *Scotia*, written by Mr. Bruce and the individual members of the staff, dealing with meteorology, zoology, biology and other scientific departments of the work of the expedition. Mr. Bruce, in his letter, stated that the *Scotia* had made a very satisfactory record, and he expressed the hope that he and his staff might be allowed to complete their researches. The appeal for funds to enable the expedition to prolong its stay in the Antarctic has now been so liberally responded to that the cruise will be continued for at least six months, and as Mr. Ferrier is still receiving donations an extension for a year may be possible. Mr. Bruce's desire will then be fulfilled. Meantime, the *Scotia* has gone north to Buenos Ayres to refit. The expedition left its winter quarters in Scotia Bay, South Orkney Islands, on November 23 —sooner than was anticipated owing to the unexpected breaking of the ice. Some members of the expedition were left behind in the winter quarters in charge of a meteorolog-

ical station. They were stocked with provisions for fully 18 months, and the place also abounds with penguins, fish and seals. Mr. Bruce reports that all on board the *Scotia* are in robust health and eager for further work.

DR. H. W. WILEY, chief of the Bureau of Chemistry, U. S. Department of Agriculture, appeared before the committee on commerce of the house of representatives on January 5, in support of the pure food bill now before congress.

THE regular annual meeting of the New Mexico Academy of Sciences, held on December 28, at Santa Fé, was well attended and interesting papers were presented. The geological part of the program included the following: Presidential address by Hon. Frank Springer on the 'Life of Louis Agassiz'; 'Note on Block Mountains,' by Dr. Charles R. Keyes; 'New Rapid Assay Method for Zinc,' by Professor Francis C. Lincoln; 'Glaciation in the High Plateau of Bolivia,' by Professor W. G. Tight; 'Revised Geological Column for New Mexico,' by Dr. Charles R. Keyes; 'Notes on Some New Mexico Minerals,' by Dr. Rufus M. Bagg; 'Some Irrigation Problems in New Mexico,' by Professor Oliver R. Smith; 'Geographic Development of South America, by Professor W. G. Tight. The president of the academy is Hon. Frank Springer, of Las Vegas; vice-president, Dr. Charles R. Keyes, president of the New Mexico School of Mines, Socorro; secretary, Professor W. G. Tight, of Albuquerque.

AT a recent meeting of the State Commission in Lunacy, held December 1, the recommendation contained in the resolution passed by the advisory board of the Pathological Institute, October 29, 1903, to the effect that: "Physicians appointed to the state hospital service should serve a preliminary term of from three to six months on Ward's Island; that the Pathological Institute and the Manhattan State Hospitals on Ward's Island organize a training school for this purpose and that provisions be made for the construction of additional accommodations in connection with the staff house at Manhattan State Hospital, west," was given careful consideration. The recommendation was adopted, and the state architect has already been notified to arrange at once plans and specifications for the construction of an addition to the staff house at Manhattan, west, to the extent of providing twelve additional bed-rooms.

AT a meeting of the British Astronomical Association, held on December 30, Sir William Ramsay gave a lecture entitled 'Some Speculations regarding Atoms and Stars.' Beginning with a sketch of the discovery of helium, he gave reasons for holding that terrestrial helium was the same as that existing in the sun, and that there was no other unknown body, asterium, associated with it in the chromosphere, as was sometimes supposed. He next pointed out that of the group of inactive gases, helium, neon, argon, krypton and xenon, only helium and krypton had been detected in stellar bodies, and went on to apply the fact that the characteristic line of krypton was prominent in the spectrum of the aurora to the explanation of that phenomenon. These five gases, having their molecules composed of single atoms, not of a pair of atoms like the other gases of the atmosphere, would get heated more rapidly than the others, and would be carried up more rapidly to the outer confines of the atmosphere by the general atmospheric circulation. Hence the top layers of the atmosphere might be supposed to consist largely of those gases. Now, Arrhenius's hypothesis was that electrified particles were shot out from the sun and in turn electrified the gases in those top layers; in this way the argon and its companions would be excited to yield their characteristic spectra. The reason why that of krypton alone was visible was, as was indicated by laboratory experiments he had carried out, because it had a greater power of emitting light than the others. The aurora might then be considered as a ring discharge round the poles of the earth, by which the yellow-green line of krypton, the line that made the aurora what it was, was caused to shine out, the streamers being the effect of the magnetic action exerted by the earth. In the latter part of his lecture, Sir William Ramsay described some of the phenomena af-

forded by radium. He described how, in addition to three kinds of rays, it gave off a self-luminous gas or emanation, which contracted very quickly—so quickly indeed that in a month it contracted itself out of existence, leaving only a purple discoloration in the glass of its tube. He told how in trying to get the spectrum of this emanation he found one of the helium lines, and a few days later discovered that the tube yielded the complete spectrum of helium, his inference being that the emanation was continually changing into helium which perhaps disappeared in the glass. The speculation was suggested that there was a limit to the size of atoms, as of stars, and that some atoms were too heavy to be stable and threw off electrons, just as the planets, on the nebular hypothesis, were thrown off by the original nebula. The atoms of bodies like uranium or radium might be supposed to have reached this limit of stability, and conceivably the electrons they shot off formed matter with simple atoms which in turn polymerized into heavier ones.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

Syracuse University has received $150,000 from the estate of the late James J. Belden. $50,000 goes to the Medical College and $100,000 to the College of Liberal Arts. Syracuse University also receives the residue of the estate of the late John Lyman. The value of the estate is not stated; but special bequests to charitable institutions were made by Mr. Lyman, amounting to over $150,000.

The new library building of Clark University was dedicated on January 14. The building has been erected at a cost of $125,000 provided by the will of the founder of the university. President Hall announced a gift of $100,000 from Mr. Andrew Carnegie for the library, this gift being made in honor of Senator Hoar, president of the board of trustees.

The Catholic University of America has received $50,000 from the Knights of Columbus for the endowment of a chair of secular history.

Princeton University has received a bequest of $25,000 from the late Louis C. Vanuxem, of Philadelphia.

E. W. D. Holway, banker of Decorah, Iowa, has given his private library and collection of fungi to the University of Minnesota. The library numbers about 1,000 volumes, including many rare and valuable works, and the collection, with some 85,000 specimens, is especially rich in illustrative material of the smuts and rusts, a group in which Mr. Holway is a well-known specialist.

Sir William H. Wills and Sir Frederick Wills have each contributed $5,000 to liquidate the debt of $25,000 at University College, Bristol. The whole sum has now been collected.

The Rev. Dr. William E. Huntington has been elected president of Boston University. He has been since 1882 dean of the university, and since the resignation of Dr. Warren last year, acting president. The trustees decided that the university should equip laboratories for chemistry, physiology, biology, geology and botany, but that the courses in physics be continued as heretofore at Massachusetts Institute of Technology.

J. H. Bair, Ph.D., Carnegie research assistant working in the psychological laboratory of Columbia University, has been appointed professor of psychology and education in the University of Colorado.

At Edinburgh University, Mr. E. M. Horsburgh has been appointed lecturer on practical mathematics; Dr. Jacob Halm, lecturer on astronomy, and Dr. H. J. Stiles, lecturer in applied anatomy.

Mr. Herbert Tomlinson, F.R.S., known for his contribution to physics, has resigned the principalship of the Southwestern Polytechnic at Chelsea, London.

Mr. R. H. Yapp, of Cambridge, has been appointed professor of botany in the University College of Aberystwyth.

Professor F. C. M. Störmer has been appointed professor of pure mathematics at the University of Christiania.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 29, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION A, MATHEMATICS AND ASTRONOMY.*

*Vice-President*—Otto H. Tittmann, Superintendent U. S. Coast and Geodetic Survey, Washington, D. C.

*Secretary*—Professor Laenas G. Weld, University of Iowa, Iowa City, Iowa.

*Member of Council*—Professor Ormond Stone.

*Sectional Committee*—Dr. G. B. Halsted, Vice-President, 1903; President C. S. Howe, Secretary, 1903; Superintendent O. H. Tittmann, Vice-President, 1904; Professor L. G. Weld, Secretary, 1904–1908; Professor W. W. Beman, one year; Dr. J. A. Brashear, two years; Professor J. R. Eastman, three years; Professor Ormond Stone, four years; Professor E. B. Frost, five years.

*General Committee*—Mr. Philip Fox.

Professor Alexander Ziwet, of the University of Michigan, was elected vice-president for the next meeting.

The Chicago Section of the American Mathematical Society and the Astronomical and Astrophysical Society of America met in affiliation with Section A. The papers presented before these affiliated societies will be noticed elsewhere. Those read before Section A were as follows:

*A New Treatment of Volume:* Professor GEORGE BRUCE HALSTED, Kenyon College, Gambier, Ohio.

In September, 1902, Poincaré wrote in his review of Hilbert's 'Grundlagen der Geometrie': "The fourth book treats of the measurements of plane areas. If this measurement can be easily established without the aid of the principle of Archimedes, it is because two equivalent polygons can either be decomposed into triangles in such a way that the component tri-

angles of the one and those of the other are equal each to each, or else can be regarded as the difference of polygons capable of this mode of decomposition. But we must observe that an analogous condition does not seem to exist in the case of two equivalent polyhedrons; so that it becomes a question whether or not we can determine the volume of the pyramid, for example, without an appeal more or less disguised to the infinitesimal calculus. It is, therefore, not certain that we can dispense with the axiom of Archimedes in the measurement of volumes. Moreover, Professor Hilbert has not attempted it.''

Professor Halsted, in the paper in question, has attacked the problem in the following manner:

The product of an altitude of a tetrahedron by the area of its base is the same whichever of the four faces may be chosen as base. This product is, therefore, a 'natural invariant' of the tetrahedron and may be designated as its volume, except that in order to adjust the conception to our ordinary numerical scale the factor *one third* is arbitrarily introduced. After defining a transversal partition of a tetrahedron as one made by a plane through an edge and a point of the opposite edge, it was shown that, however this solid be cut by a plane, the partition can be obtained as a result of successive transversal partitions, using not more than two other planes.

The above being explained, it was shown that the volume of any tetrahedron is equal to the sum of the volumes of all tetrahedrons which result from any set of transversal partitions. This need not be assumed as self-evident, but may be demonstrated as a necessary consequence of the so-called 'betweenness' assumption with reference to three co-straight points. Similar principles were deduced for polyhedrons in general, and by their use a general theory of volume was built up without reference to the ordinary notions of ratio and commensurability. The same method of treatment may be applied to figures in hyperspace of any order.

*Lines on the Pseudosphere and the Syntractrix of Revolution:* E. L. HANCOCK, Purdue University, Lafayette, Indiana.

The lines of the pseudosphere are reviewed and those of the syntractrix of revolution studied. The latter surface $S_1$ is defined as the surface generated by the revolution of the curve $C_1$ about its asymptote; $C_1$ being determined by laying off a constant distance $d$ on the tangents of the tractrix.

The geodesic, asymptotic and loxodromic lines on $S_1$ are worked out and studied by classifying the surfaces according as

$$d \gtreqqless 2c,$$

$c$ being the constant of the tractrix. When $d \geqq 2c$ it happens that the geodesic lines on $S_1$ are all real; while for $d < 2c$ they are real or imaginary according as

$$\kappa^2 \lesseqgtr \left| \frac{c^2 d^2}{d^2 - 4cd} \right|,$$

$\kappa$ being a constant of integration.

The loxodromic lines of the syntractrix of revolution are represented in the plane by the same system of straight lines as represent the loxodromic lines of the pseudosphere.

*The Rotation Period of the Planet Saturn:* Professor G. W. HOUGH, Director of Dearborn Observatory, Evanston, Ills.

In 1877 Professor Asaph Hall, then at the U. S. Naval Observatory, observed a spot near to Saturn's equator and by its means determined the period of the planet's rotation. From that time on, until the recent opposition, no well-defined spot has been visible. On June 23, 1903, however, Professor E. E. Barnard, of the

Yerkes Observatory, noted a large and distinct spot in Kronocentric latitude 36°.5. This was observed micrometrically on June 27 and July 13.

Acting upon the request of the author, micrometric observations of spots on Saturn were made by Professor S. W. Burnham with the 40-inch Yerkes equatorial. Measurements were secured on July 29 and August 15. From these data the 'mean' rotation period deduced was $10^h\,38^m\,27^s$; but the observations showed the period to be variable. The value $10^h\,38^m\,18^s + n \times 0^s.1856$ was found to satisfy all the observations with a mean error of $\pm\,0^m.8$. In the formula $n$ is the number of rotations of the planet counting from the epoch of the discussion, June 23, 1903.

*An Extension of the Group Concept:* Dr. EDWARD KASNER, Columbia University, New York.

Read by title.

*Facilities for Astronomical Photography in Southern California:* E. L. LARKIN, Director of Lowe Observatory.

Attention was called to the fact that, from May 1 to November 1, the observer upon Echo Mountain enjoys an almost unbroken succession of cloudless days and nights. During the greater part of this season the air becomes remarkably steady shortly after sunset; so much so that the rings of Saturn may be seen rising as a minute but sharply defined arch over the crest of the neighboring mountain ridge. In the rainy season, after a shower, the air is of such transparency that mountains distant a hundred miles or more may be seen with clearness and distinctness.

In view of these conditions Mr. Larkin urged the establishment of an observatory equipped for astro-photography upon the summit of Echo Mountain. Attention was called to the faint nebulous light forming the background of large regions of the sky as observed from this station. Some interesting views of Lowe Observatory and its surroundings were projected upon the screen, together with a number of the famous Lick Observatory photographs.

*Coincident Variations:* LUCINUS S. McCOY, Whitten, Iowa.

Read by title.

*On the Generalization and Extension of Sylow's Theorem:* Dr. G. A. MILLER, Stanford University, California.

Dr. Miller's paper, which will shortly be printed in full, is in abstract as follows:

Let $p^a$ be the highest power of $p$ which divides the order of a group ($G$), and suppose that a subgroup ($P_a$) of order $p^a$ contains only one subgroup ($P_\beta$) of order $p^\beta$ and of a particular type. It is proved that the number of subgroups of $G$ which are of the same type as $P_\beta$ is of the form $1 + kp$, and that all of these subgroups form a single conjugate set. Hence the order of $G$ is of the form $p^\beta h_1(1 + kp)$ where $p^\beta h_1$ is the order of the largest subgroup of $G$ which transforms $P_\beta$ into itself. By letting $\beta = a$ we have Sylow's theorem. When $\beta = a$ the factor $h_1$ is not divisible by $p$ while it is divisible by $p$ for all other values of $\beta$. Some simplifications of the proof of Frobenius's extension of Sylow's theorem are also considered.

*The Supporting and Counter-weighting of the Principal Axes of Large Telescopes:* C. D. PERRINE, Lick Observatory, Mt. Hamilton, California.

In large telescopes it is necessary to reduce the friction of the axes in their bearings. This has usually been done by a system of friction wheels held against the axis by weights and levers.

Experience with the roller bearings used in the driving-clock for the new mounting

of the Crossley reflector suggested the same principle as being suitable for the axes of large telescopes. These bearings are very simple in construction and consist of a ring of hardened steel rollers around the axis, in the bearing. The rollers fit closely about the axis and, therefore, do not require any frame to hold them in their relative positions. There is no looseness and the axis revolves with perfect accuracy, yet easily.

Such bearings would be fully as efficient in the case of a large overhang of the polar-axis as in the ordinary form of mounting. Where the ends of the polar axis are supported on separate piers the bearings can be made self-aligning.

*A Linkage for Describing the Conic Sections by Continuous Motion:* J. J. QUINN, Warren, Pa.

This linkage is the material embodiment of the facts set forth in the following theorem:

If one vertex of a movable pivoted rhombus be fixed in position, while the opposite vertex is constrained to move in the arc of a circle, the locus of the intersection of a diagonal (produced) through the other two vertices, with the radius (produced) of the circle in which the vertex moves is a conic.

If the fixed vertex is in the diameter of the circle, and the directing radius finite, the locus is an ellipse. If the directing radius is infinite and the fixed vertex in the diameter, the locus is a parabola. If the directing radius is finite, and the fixed vertex is in the diameter produced, the locus is a hyperbola. Modifications of the essential features of this linkage give rise to many interesting corollaries involving the geometric construction of the conics, their tangents and normals.

*Circles Represented by $\mu^3P+L\mu^2Q+M\mu R+NS=0$:* T. R. RUNNING, Ann Arbor, Michigan.

In the equation discussed $\mu$ is a variable parameter; $L$, $M$ and $N$ are constants; $P$, $Q$, $R$ and $S$ represent circles. The equation itself represents circles for all values of the parameter. Three circles of the system pass through each point of the plane. The locus of the centers of the system is a cubic having eight arbitrary constants.

There will be a circle orthogonal to the system if any one of the circles $P$, $Q$, $R$, $S$ can be derived linearly from the other three. There are six point circles in the system, all lying upon the locus of the centers. Four circles of the system are tangent to any one. Eight pairs of tangent circles have a common linear relation connecting their parameters.

The envelope of the system is

$$18\,LMNPQRS-27\,N^2P^2S^2+L^2M^2Q^2R^2 -4(L^3NQ^3S+M^3PR^3)=0$$

which may be written

$$B^2=4AC,$$

where

$$A=L^2Q^2-3PMR,\quad C=M^2R^2-LQNS,$$
$$B=LMQR-9PNS.$$

It is shown that this is the envelope of

$$\mu^2A+\mu B+C=0,$$

$A$, $B$, $C$ being bicircular quartics which are themselves envelopes of systems derived from the original circles.

The envelope of the radical axes of a particular circle and other circles of the system is a conic. This conic may be said to correspond to the particular circle, and there is such a conic corresponding to every circle of the system. The system of circles represented by

$$\mu^3P+L\mu^2Q+M\mu R+NS=0$$

is called the primary system, and the sys-

tem of conics corresponding to it in the manner above explained, the secondary system. It is shown that the equation of a conic of the secondary system is of the fourth degree with respect to the parameter and that, therefore, four conics of the secondary system pass through any particular point in the plane.

The equation of the radical axis of two circles, $\mu$ and $\mu'$, of the system is

$$y=\frac{F}{G}x+\frac{H}{G},$$

$F$ and $H$ being of the fourth degree in $\mu$ and $\mu'$ and $G$ of the third degree. It thus appears that there are sixteen sets of values of $\mu$ and $\mu'$ for which this equation represents the same radical axis; that is, there are sixteen pairs of circles having the same radical axis. Moreover, to these thirty-two circles there correspond thirty-two conics of the secondary system, all of which are tangent to the same radical axis.

The paper includes, by way of introduction, a brief discussion of the equation

$$\mu^2P+L\mu Q+MR=0.$$

*A New Type of Transit-Room Shutter:* Professor DAVID TODD, Amherst, Massachusetts.

The type of shutter here described is that used to cover the two transit slits of the new observatory of Amherst College. These slits have a clear opening of 100° each way from the zenith and are three and one half feet in width. Each shutter is twenty-one feet long and sixteen feet high. It is made of structural steel with two vertical members and one truss member across the roof. Its weight is about three thousand pounds.

The entire shutter moves as a unit upon ball-bearing rollers underneath the vertical members. These rollers travel upon rails lying east and west along the north and south walls of the building. The two ends of the shutter are made to travel in unison by means of rack and pinions with sprocket wheels and link-belt chain.

The roof-member travels ten inches above the roof of the transit room, thus clearing all ordinary depths of snow. Only the bottom of this member is covered in, the structural elements of its top and sides being left exposed as in bridge work. Wind thrust is thereby minimized.

The entire shutter opens or closes full width in four seconds, by eight turns of a hand wheel. A small shaft lock holds it firmly in either position.

LAENAS GIFFORD WELD,
*Secretary.*

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### *SECTION G, BOTANY.*

SECTION G at the St. Louis meeting was organized, under the chairmanship of Professor T. H. Macbride, on December 28, 1903. The other officers were as follows:

*Secretary*—F. E. Lloyd.

*Councillor*—Wm. Trelease.

*Sectional Committee*—T. H. Macbride, vice-president, 1904; F. E. Lloyd, secretary, 1904–1908; F. V. Coville, vice-president, 1903; C. J. Chamberlain, secretary, 1903; W. A. Kellerman (one year), F. S. Earle (two years), C. E. Bessey (three years), W. T. Beal (four years), F. E. Clements (five years).

*Member to General Committee*—C. L. Shear.

Meetings of the section for the reading of papers and for other business were held on December 28, 29, 30, 31 and January 1. The Mycological Society and the Botanists of the Central States met conjointly with the section.

A committee consisting of Professor C. E. Bessey, Dr. B. T. Galloway and Professor C. MacMillan drew up a resolution strongly endorsing the efforts at present being made looking toward the passage of such laws by Congress as will provide for the perpetual preservation of the Calaveras Grove of Big Trees in California.

On Friday morning the section, together

with visiting botanists, had the pleasure of paying a visit to the Missouri Botanical Garden, where, under the guidance of Dr. Wm. Trelease and his staff, the various appointments and collections were examined with great profit and enjoyment. The section returned a vote of thanks to Dr. Trelease for his courtesy to the visiting botanists.

The following papers were presented:

*The Work of the Year 1903 in Ecology:* H. C. Cowles. (By special invitation of the sectional committee.) This paper will be published in full in Science.

*Notes on the Botany of the Caucasus Mountains:* C. E. Bessey.

General characteristics of the mountains and their climate. The steppes north of the range. The vegetation of Kislovodsk, Bermamut, Kasabek and Ardon, on the north side. Vegetation of the Ardon Valley, the higher mountain slopes and the Rion Valley to Kutais. The forests of Colchis. Tiflis and its botanical garden. The region of Upper Armenia. The plains of Erivan on the Zenga River. The gardens at Batum and Chackva. Tea plantations and bamboo thickets at Chackva. The forests of the northeast shores of the Black Sea.

*The Cypress Swamps of the Saint Francis River:* S. M. Coulter.

The Saint Francis River covers wide stretches of lowland in Missouri and Arkansas with a varying depth of water. At some seasons these lands are dry, at others covered with two feet of water. Submerged aquatic plants cover the river bottom and *Polygonum densiflorum* seems to be the first aerial plant; *Zizaniopsis miliacea* succeeds it very closely; *Peltandra undulata, Saururus cernuus* and *Typha latifolia* are next in order, then a willowy undergrowth, succeeded by *Cephalanthus occidentalis; Nyssa uniflora* and *Taxodium distichum* occupy the next zone and are the principal forms which have worked out so-called adaptations to their habitat.

The young trees of *Nyssa uniflora,* the tupelo gum, are crowded in pure groves, and as they increase in size they develop a peculiar bulging in the trunk near the water line. These dome-shaped bases become as much as twelve feet in diameter and are accompanied by the decay of the central tissue in base and trunk. Upper portions of the trees are usually blown away, leaving a hollow shaft thirty or forty feet high. The habitat of the cypress is similar. The young groves are not so unmixed as those of the tupelo. The cypress base, instead of being dome-shaped, becomes conical, but does not decay in the center. The development of the cypress 'knees' or upward enlargements of the roots is another peculiarity of the cypress growing in water. They are enormously developed in the Saint Francis region, sometimes reaching a height of eight feet above the ground. When cypress grows under mesophytic surroundings, neither the enlargement of the base occurs nor the development of knees. Beyond the cypress-tupelo gum association is found a large variety of shrubs and trees. The tension line between the cypress and most broad-leaved trees seems dependent upon the amount of water; the cypress can live on land or water, but the other forms only on land. However, they are more vigorous under those favorable conditions and soon occupy the land to the exclusion of the cypress. These marginal forms include *Liquidambar styraciflua,* white and red oaks, sassafras, sycamore, *Celtis Mississippiensis, Nyssa sylvatica* and a large number of shrubs.

*Ecological Notes on the Islands of Bermuda:* S. M. Coulter.

The Bermuda Islands are composed of porous limestone with a thin covering of soil. The nature of this substratum prevents the accumulation of water excepting a few brackish ponds near the level of tide-water. Conditions of moisture and exposure are very uniform, hence plant associations are not large, nor do they vary widely. The largest ecological area comprises in a general way all the hillsides and slopes that have sufficient soil to support a large vegetation. Their appearance is somber on account of the large number of cedars which cover them. Two species of *Lantana* (called the Bermuda sage-brush) are associated with the cedars, and crab-grass and cape-weed cover the ground. Tall oleanders are marginal to the cedar groves and *Yucca alsifolia* is abundant along the cliffs. A second area comprises the rocky shores along the ocean, characterized by gnarled forms of *Conocarpus erectus, Borrichia arborescens, Solidago sempervirens* and *Opuntia Tuna.* A third area is formed by the sandy beaches and small dunes along the south shore. The sea blackberry, *Scœvola lobelia,* is the most abundant form and *Ipomœa pes-capræ* is almost as common, trailing its long vines over the sands and helping to bind them together. Secondary in importance are *Cakile æqualis, Tournefortia gnaphaloides,* the golden-rod mentioned above and the sea ox-eye, *Borrichia arborescens.* These mesophytic and xerophytic areas are most prominent, but there are two types of swamps to be noted. The Devonshire marsh was apparently once a large pond but there is little water left. Two species of *Sphagnum, Proserpinaca palustris, Typha latifolia* and *Eichornia* occupy the lower pools. *Hydrocotyle Asiatica* and *Herpestis monniera* are rooted in the mud. *Osmunda Cinnamomea* and *O. regalis* are abundant in somewhat drier places, while in the dry, peaty soil *Pteris aquilina cordata,* the cedar, palmetto and dog-bush are most common. The mangrove swamps about small inlets of the sea constitute the second hydrophytic area. The aerial roots from the limbs of *Rhizophora Mangle* and the curving prop-roots add considerable interest to these swamps. The seeds begin to grow on the trees, then drop into the mud, their pointed ends fixing them upright, while the growing roots soon penetrate the soil and a pair of leaves appear at the upper end. *Avicennia nitida,* the false mangrove, is associated with the true and along the tide-water margins are *Salicornia fruticosa, Statice Lefroyi, Sesuvium Portulacastrum* and *Coccoloba uvifera.*

*A Lichen Society of a Sandstone Riprap:* BRUCE FINK.

A general discussion of the conditions under which the society has developed and is now growing, including some statement as to amount of moisture in various portions of the riprap, amount of disintegration at various points and amount of exposure to sun and wind. Following this is a consideration of the ecologic conditions and resulting spermaphytic flora in the area, and the effect of these surroundings on the composition of the lichen society. Next in order is given a list of the lichen species of the society, followed by a discussion of the conditions under which each species is growing and the adaptations of each species to these conditions. Brief comparisons are made between this society and three others found on sandstone, and herein are shown some very marked responses between ecologic conditions and structural adaptations.

*Relation of Soil to the Distribution of Vegetation in the Pine Region of Michigan:* E. B. LIVINGSTON.

The study here reported is of about fifteen townships lying in Roscommon and

Crawford Counties, Michigan. The soils are classed as clay, clay loam, sandy loam, and sand, power to hold and lift water from an underground water level decreasing with the different soils in the order named. The region is glacial and consists of ridges and plains. The former are usually gravelly and sandy loam. The latter are loamy sand, clay or nearly pure sand. Some ridges are quite clayey. The vegetation is divided into (I.) upland and (II.) lowland types. Of the former are considered the following, named for the characteristic tree species: (1) The hardwood, (2) the white pine, (3) the Norway pine and (4) the jack pine. These types become more xerophytic in character in the order named. In general, the upland types follow in their distribution the distribution of the soils, the hardwood occurring on low clay plains, on swamp margins in loamy soil, and on certain plains of loam which are well covered with humus. The white pine occurs on certain ridges of clay loam and of clay and also on swamp margins in loam and clay. The Norway pine type is found on loamy sand plains and on the ridges of sandy and gravelly loam. The jack pine type occupies exclusively the well-washed sand plains. The only complicating factors in distribution are the effect of humus (which seems able to make even sand able to support hardwood) and the effect of the rise of the underground water level, as at swamp margins. The latter makes a sandy soil able to bear vegetation which would otherwise be found only in loam or clay. Analyses of the soil seem to show that its chemical properties are unimportant, that the real factor to determine distribution is the power of the soil to hold water, this power increasing with fineness of particles or with presence of humus.

*Research Methods in Phytogeography:* F. E. CLEMENTS.

(1) The use of simple and automatic instruments, photometer, psychrometer, thermometer, etc., in the exact determination of the physical factors of a habitat; (2) the study of the structure and development of formations by means of permanent and denuded quadrats, and migration circles; (3) experimental ecology in the field by moving plants from one habitat to another, or by modifying the controlling factor of a habitat; (4) experimental ecology in the plant house by equalization and control of physical factors.

*Ensayo para la formacion de un foto-herbario Botanico y medico de la flora Mexicana:* FERNANDO ALTAMIRANO.*

Contendrá una collección de 6000 fotografías tomadas de los especimenes del Herbario de Plantas Mexicanas del Instituto Medico Nacional. Cada fotografía será de y llevará dos etiquetas: una corresponderá al Colector y tendrá los datos de clasificación, lugar de vegetación, etc., y la otra corresponderá al instituto, conteniendo los nombres vulgares, las rectificaciones que se hayan hecho á la clasificacion, etc. Cada lámina del Foto-herbario, que contendrá 4 foto-grafías, irá accompanada de una hoja de igual temaño (0.20 por 0.25 próximamente), conteniendo datos descriptivos, aplicaciones y la distribución geográfica con su mapa respectivo. Las plantas del Herbario serán fotografiadas en órden de familias naturales, comenzando por las Ranunculaceas. Cada lámina contendrá solamente especies de un mismo género, especies que irán numeradas progresivamente, tal como se representa en la muestra que se remite, la cual comprende 100 fotografías. La impresión del texto y el tiro de las láminas, lo hará

* La palabra foto-herbario sera substituida por otra si se considerare inadecuada.

el Instituto, en número de 1,000 ejemplares, que repartirá en toda la República y á las corporaciones científicas extrangeras. El objeto de la publicación de este Foto-herbario es facilitar el conocimiento de nuestras plantas á toda clase de personas, aún de aquellas que sean menos versadas en la Botánica. Para eso se presenta la figura de la planta que atraé la atención y facilita las descripciones; y por eso tambien se dán á conocer las aplicaciones y el lugar donde vegeta una planta, lo cual aumenta el interés por conocerla y facilita su adquisición á los colectores. Formará pues, este Foto-herbari o un catálogo como el que acostumbran publicar los botánicos de sus herbarios; pero con la ventaje de que el Foto-herbario es un catálogo y un herbario á la vez, podriamos decir, acompañado de otras muchas notisias que no se acostumbra poner en los simples catálogos. Este Foto-herbario puede tener una aplicación más amplia todavía, y ese es mi deseo, que comprenda las Fotografías de todas las plantas mexicanas conocidas. Para consequirlo me propongo que tambien sean fotografiados los especimenes de los herbarios extrangeros que no tengamos en los de México. Asi por ejemplo, procurarémos fotografias de aquellas plantas mexicanas, de los herbarios de los Estados Unidos, de los de Europa, etc. A la vez que trabajemos en México se procurará que tambien se trabaje, sobre el mismo asunto, en los herbarios de fuera, siguiendo un plan determinado para que cuando al fin de algún tiempo (dos años probablemente) que se haya completado le colección de las fotografías de la Flora Mexicana, no resulten desordanadas ni haya repeticiones. Si pues se considerare útil la publicación del Catálogo del Herbario del Instituto, según la manera que he indicado, y que sea aplicable á toda la Flora Mexicana, procuraremos fotografiar cuanto antes, todas las plantas de los herbarios que haya en México, y yo me atreveré á pedir desde ahora la valiosísima cooperación de los botanicos de todas las naciones. Ojalá que esta autorizada Asociación tuviera á bien iniciar el monbramiento de una Comisión que se siriera dictaminar sobre cual seria la mejor manera de llevar á cabo la formación de un Catálogo General de la Flora de cada Nación ó sea un Foto-herbario-Pan-Americano.

*The Alamogordo Desert; A Preliminary Notice:* THOMAS H. MACBRIDE.

The Alamogordo Desert is situated in southwestern New Mexico; it is a bolson, *i. e.*, an undrained desert plain. The topography of the region and its geology are briefly described and an effort made by illustration and description to connect the present distribution of the flora with geological history. It is claimed that in this desert, as often in other parts of the country, the distribution problems can be understood only as the geologic story is more or less perfectly read. The flora of the plain is contrasted with that of the mountain side and summit.

*The Flora of the St. Peter Sandstone in Iowa, An Ecological Study:* B. SHIMEK.

The distribution of the St. Peter exposures in Iowa. The physical characters of the St. Peter sandstone. A brief discussion of the plants which are peculiar to it. A corresponding discussion of the plants which are common to rocky ledges and which also occur on the St. Peter sandstone. A more detailed discussion of a series of plants which normally belong to other habitats, but which have gained a foothold on the sandstone, or on the sands resulting from the decomposition of the sandstone. These latter are very much developed.

*An Ecologically Aberrant Begonia:* William Trelease.

An account of a Mexican species of *Begonia* possessing a single large sessile leaf closely applied to the cliff on which the plant grows, so as to afford protection to its roots.

*Plant Formations in the Vicinity of Columbia, Mo.:* Francis Daniels.

The vegetation of the region falls into four main classes: (1) The aquatic and subaquatic floras; (2) the mesophytic, or in poor soil, xerophytic, sylvan flora; (3) the rupestrine flora of the limestone cliffs; (4) the cultural and ruderal floras. The aquatic and subaquatic vegetation falls into six zones: The aquatic, amphibious, limose, ulignose (wet swamp), paludose (open marsh) and riparian zones. The mesophytic (or xerophytic) sylvan flora assumes five main types: The alluvial, the mesophytic sylvan proper, the open brush, the arborescent glade and the sterile hill type. The rupestrine flora exhibits four types: The fontinal or dripping rock, the soil-covered ledge, the bare rock and the cliff summit types. The cultural and ruderal floras have the forms proper to pastures, meadows, fields, orchards, gardens and waste places. Besides these there are a host of parasitic and saprophytic fungi, and a few flowering plants, like *Cuscuta, Thalesia* and *Monotropa.*

*The Distribution of Some Iowa Plants; Formations on which they Occur:* L. H. Pammel.

A brief account of some of the more important plants found on the carboniferous sandstone in eastern Iowa, noting the occurrence of the white pine, *Pinus Strobus, Gaylussacia resinosa, Aspidium marginale, A. acrostichoides, Lycopodium lucidulum, Phegopteris Dryopteris, Diervilla trifida* and *Danthonia spicata.* The occurrence of boreal types like *Salix candida, Lobelia Halmii, Cnicus muticus, Gentiana crinita.*

*The Chemical Constituents of a Soil as Affecting Plant Distribution:* S. M. Tracy.

The author calls attention to the fact that the distribution of plants is often attributed wholly to the physical and mechanical condition of the soil, though in many cases the chemical constituents of the soil are equally potent.

*Vegetation of the North Shore of Lake Michigan:* C. MacMillan.

A brief sketch of the characteristic shore and forest vegetation of the North Shore. The strong resemblance of this to the mountain vegetation of British Columbia was pointed out. Not only does the resemblance appear in the many northern species, but more particularly in the general association of plants and the relative preponderance of generic types.

*Zones of Vegetation About the Margin of a Lake:* W. J. Beal.

About a mile and a half northwest of Lansing, Mich., is a natural pond which goes by the name of Jones' Lake with an outlet at the west. The lake is nearly circular in outline and about forty rods in diameter. There is a slight extension both to the north and to the south. The bottom and the shaky margins all around consist uniformly of dark mud, ooze or muck. The lake contains a few species of fish, such as sunfish, blue gills and spotted bass. From the soft banks within two to three rods, the bottom uniformly descends rapidly to deep water. I examined the margins of this lake on August 23, 1903. Beginning with the deep water this is the order of the bands of some of the leading

kinds of plants: (1) Potamogetons, not yet in fruit, prominent among which was *Potamogeton amphifolius* Tuckerman, which formed an unbroken band about the margin of the lake. (2) In most places a narrow strip of some species of *Chara*. (3) *Castalia tuberosa* (Paine) Greene, and *Nymphæa advena* Soland, usually mixed, but sometimes only one or the other, formed a band ten to thirty feet in width, and this band was rarely broken, and then only for a space of ten to thirty feet. (4) In many places were narrow patches of *Pontederia cordata* L., but scarcely ever in long strips. (5) *Typha latifolia* L., with very rarely an exception of a few feet, formed a band from five to twenty feet in width. (6) Sedges in variety with some species of rushes and grasses, and others of like needs formed an uninterrupted band. (7) Several species of *Salix*, or some one or two, surrounded the lake completely. (8) A band of *Larix laricina* (Du Roy) Koch was unbroken excepting for a few rods on the north, where it may have been formerly cut away next to a cleared farm. As the condition of the margins of the lake and surrounding it are so nearly uniform, we have reason to expect the zones of vegetation will be little if at all interrupted. As the descent of the bottom from the flat margins of the lake to the deep water are so rapid, there is only room for narrow zones of vegetation. Beyond the eighth zone (of *Larix*) in two places for a quarter of the circumference the slope rises rapidly to dry arable land, while in the remaining three fourths there are many kinds of aquatic and lowland plants. In all his travels, the author never remembers to have seen a place where so many zones of plants were so well marked for so long a distance as were found at Jones' Lake.

*The Genus Harpochytrium, its Development, Synonymy and Distribution:* G. F. ATKINSON.

Describes the genus *Harpochytrium*, its structure, formation of sporangia and spores; the movement of the spores and attachment to host. Also discusses the synonymy as well as the distribution of the genus in different parts of the world.

*The Phylogeny of the Lichens:* F. E. CLEMENTS.

(1) A general consideration of the underlying principles of polyphylesis; (2) a detailed discussion of the points of contact of fungi and lichens; (3) the treatment and classification of lichens as parasitic fungi.

*The Necessity for Reform in the Nomenclature of the Fungi:* F. S. EARLE.

Cites the conflicting usages in Engler and Prantl's 'Pflanzenfamilien' and in Saccardo's 'Sylloge Fungorum' to show that there is no unanimity in the use of genus names for fungi at the present time. Shows from unpublished data in regard to the types of the earlier genera that in forty-five per cent. of these cases the earliest available name is not used by Saccardo. Shows that this process of shifting generic names from one group of species to another is still in progress and urges that immediate steps be taken to put a final stop to the practice.

*Taxonomic Value of the Spermogonium:* J. C. ARTHUR.

The physiological significance of the spermogonium is yet unknown. It had been tentatively assumed to be associated with sexual reproduction as the male structure. It has been known for more than fifty years, and it still bears the name given by the discoverer, Tulasne, but its sexual character is still problematical.

The numerous forms of spores among the Uredineæ are shown to belong to two classes, the teleutospores, which are doubtless of a sexual character, and conidia, the latter being either æcidia or uredo. These follow in an invariable order. The spermogonium always appears in the life cycle as the first fruiting structure. If the first subsequent spore structure is the uredo, there is no æcidium in the cycle; if it is in the teleutospore, there is neither æcidium nor uredo. The presence and association of the spermogonia, therefore, furnish important information regarding the extent of the life cycle. The characters drawn from form, size and origin of the spermogonia furnish minor characters. The spermogonia, as well as any or all of the conidia, may be suppressed in certain species.

*Proof of the Identity of Phoma and Phyllosticta on the Sugar Beet:* George G. Hedgcock.

This paper gives the results of a cultural study of *Phoma betæ* and *Phyllosticta tabifica* in which two fungi are shown to be identical, both causing a similar rot of the root of the sugar beet, and producing upon inoculation upon the leaves the typical *Phyllosticta* leaf spots. The cultural characters of the two fungi are identical.

*Craterellus taxophilus, A New Species of Thelephoraceæ:* C. Thom.

A delicate fleshy *Craterellus* found at Ithaca, N. Y., is described and figured as new. Photographs, specimens and drawings of structure are presented, and show it to differ from previously described species. Its association with *Taxus*, which seems very close, is made the basis of the specific name. The technical description of the species as *Craterellus taxophilus* is added.

*The Fungi Cultivated by Texas Ants:* A. M. Ferguson.

The fungi found in the so-called 'mushroom gardens' of certain fungus-eating ants occurring in central and southern Texas (*Atta fervens* Say, *A. septentrionalis* McCook, *A. turrifex* Wheeler and *Atta* n. sp. Wheeler) consist of a white slow-growing mycelium with characteristic clusters of terminal swellings, the 'Kohlrabihäufchen' of Möller, which are eaten by the ants. While no kind of spore formation was found, it is probably the same as the form described by Möller from the gardens of Brazilian *Attas*. The fungus grows slowly in culture, but was often more vigorous than in the garden under the control of the ants. The formation of the characteristic swellings seemed to be governed by local conditions (probably controlled in the garden by the ants), for in cultures, on beans, for example, they would be formed in abundance in some tubes and not at all in others. Efforts to feed one species with the fungus grown in the garden of another, or from cultures, gave erratic results, rarely succeeding, and then only after prolonged starving. Some observations of Möller bearing on the systematic position of the fungus were unconfirmed. A *Dematium*-like fungus proved to be the organism cultivated in the nests of *Cyphomyrmex rimosus*. This ant was supposedly carnivorous until its fungus-feeding habit was observed by Dr. W. M. Wheeler. In this case caterpillar pellets are used exclusively by the ants for a medium upon which to grow the fungus.

*Symbiosis in Lolium:* E. M. Freeman.

In a previous paper I have described the unique year-cycle of the fungus symbiont of *Lolium temulentum* and other species of *Lolium*. Further experiments support the theory that the fungus does not form spores. There are two races each, of *L.*

*temulentum*, *L. perenne* and *L. linicola*, one with and one without the fungus symbiont. Of these the with-fungus race is the slightly more vigorous. Present knowledge points to the probability that the fungus is an *Ustilagene*, which has lost its power of spore formation and has adopted a method of intraseminal mycelial infection at the first appearance of the stem growing point. Infection of without-fungus plants seems impossible, as is also the elimination of the fungus from the with-fungus plants.

*Mitotic Division of the Nuclei in the Cyanophyceæ:* EDGAR W. OLIVE.

The 'central body' in the Cyanophyceæ is a nucleus, not essentially different from the nuclei of higher plants. When conditions for growth are favorable, the vegetative cells divide with unparalleled rapidity, so that their nuclei are rarely in a state of rest. Consequently during this period of mitotic division a nuclear membrane is not present. In spores and heterocysts, on the other hand, the nuclei form nuclear membranes and they resemble, furthermore, in other respects the resting nuclei of the higher plants. When in division, the 'central body' is made up, for the most part, of a more or less dense kinoplasmic achromatic substance, which corresponds to the spindle, and which is composed both of mantle fibers, attached to the partition walls of the cell, and of connecting fibers. The chromosomes, which can be successfully demonstrated only by careful differentiation of stained material, are very minute, and are usually sixteen in number. In the large species *Oscillatoria princeps* and *O. Froehlichii*, however, there are thirty-two, while in *Nostoc communè* and in *Gleocapsa polydermatica* there are but eight chromosomes. In *Gleocapsa* the plane of division of the chromosomes is exceptional, in that it takes place at right angles to the resulting plane of division of the cell. In all the other forms studied, embracing five genera, the plane of division of the chromosomes is normal, being parallel to the resulting plane of division of the cell. In the filamentous forms division of the cells takes place with wave-like regularity; and in all cases studied, with the exception of *Gleocapsa*, division of the cell is accomplished by the growing in from the peripheral wall of a ring-formed wall. In *Oscillatoria* several ring-shaped walls, in different stages of growth, may be present at the same time in the same cell, long before the one first formed has completely divided the cell. Two kinds of granular inclusions, which are characteristic of the Cyanophyceæ, the cyanophycin granules and the slime globules, or 'central granules,' are usually present in the cytoplasm. The peripheral position of the cytoplasm is generally differentiated into a denser, fibrous region—the chromatophore—which contains the diffused green and blue coloring matters. No evidence whatever was found of the presence of minute globular chloroplasts, such as several investigators say are present in certain forms. In this investigation the conclusion was reached that the cell organization of these low plants can not be successfully studied except in thin sections, cut longitudinally as well as crosswise.

*Chemical Stimulation of Algæ:* E. B. LIVINGSTON.

The study was carried on with the polymorphic form of *Stigeoclonium* previously worked with by the same author. In the previous work it was shown that with relatively high osmotic pressure of the medium the alga produces only spherical cells, a *Palmella* or *Pleurococcus* form. With low osmotic pressure it grows out with long branching filaments. Zoospores are formed

only with low osmotic pressure and they germinate to form filaments. If filaments are placed in a medium of high pressure they break up into round cells or form groups of round cells. When the solution of low osmotic pressure has added to it a trace of such a poison as nitric or sulfuric acid, copper sulphate, silver nitrate, etc., the alga takes the *Palmella* form as though the pressure were high. If the poison is still more dilute there is a stimulation of zoospore production, though the zoospores are checked in germination. Nitrates and sulphates were used and it appears that the poison kations have the effect of producing the *Palmella* form in a solution whose osmotic pressure is far too low to bring about this result. The kations so far studied are: H, Li, Rb, $NH_4$, Cu, Ag, Al and Fe. All of these also produce stimulation of zoospore production when in weaker solution, and to the list may be added Ba and Sr.

*The Differentiation of the Strobilus:* F. E. Clements.

(1) A brief consideration of the antithetic evolution of the sporophyte from *Tetraspora* to *Anthoceros;* (2) a discussion of the probable origin of *Selaginella* and *Isoetes;* (3) the derivation of the strobilus of *Pinus, Myosurus* and *Alisma* from *Selaginella;* (4) the general ecological principles involved in the modification of the strobilus; (5) the essentials of the phylogenetic method.

*The Histology of Insect Galls:* M. T. Cook.

The function of the gall is to furnish nutrition and protection for the larva. The simplest galls only show two zones, the inner nutritive and the outer protective. The most highly developed galls show four zones, the second and third often separated; the innermost zone is nutritive and the other protective. When the gall first forms it is a mass of irregular parenchyma cells which soon become differentiated into the zones. In the simplest galls, where we have only two zones, the inner nutritive zone is rich in protoplasm, starch, etc., until the insect is near maturity, while the other zone forms tannin. In the most highly developed galls, tannin is also developed in abundance. The innermost zone is very rich in nutrition, the remaining three zones are protective. The separation of the second and third zone is undoubtedly a protective device. The shape of the gall and its complexity are probably due to efforts for protection against parasites and birds.

*Morphology of Caryophyllaceæ:* M. T. Cook.

Some time since the writer published a short paper on *Agrostemma Githago* L. and *Claytonia Virginica* L. Among the most interesting points in these papers was the formation of the peculiar beak to the ovule and the two zones of the nucellus in *A. Githago.* The writer has since continued the study upon two species of the Caryophyllaceæ for the purpose of demonstrating the importance, if any, of the morphology of the embryo sac and surrounding structure in taxonomy. The two species selected for study were *Vaccaria Vaccaria* (L.) Britton and *Alsine pubera* (Michx.) Britton. In both cases a beak is formed similar to *A. Githago* and the embryo follows a similar line of development, but the sac enlarges in the same manner and direction as in *C. Virginica.* Other points are as yet not definitely determined.

*The Phylogeny and Development of the Archegonium of Mnium cuspidatum:* G. M. Holferty.

After brief statements in regard to the collection and method of treatment of material, and the terminology to be used, the author reviews the more important litera-

ture on the development of the moss archegonium from 1851 to the present. A summary of this literature shows considerable divergence in the opinions and interpretations of the several investigators. The crux of discussion has been in respect to the origin of the members of the axial row, but particularly whether the terminal cell (cover cell of liverworts) adds to the row after its first division. The discovery of a mitotic figure in this cell after one cell had been cut off enables the writer to decide this question affirmatively. In a second part of the paper, the author demonstrates the homology of archegonia and antheridia from the standpoint of (*a*) homology of the organs as indicated in early stages of development; (*b*) homology of the egg and other members of the axial row; (*c*) the homology of the members of the axial row and sperm mother cells. From certain bisexual organs, and from abnormal or slightly modified forms of both archegonia and antheridia, the author is able to offer support to recent views as to the phylogeny of the archegonium and to throw light upon the meaning of abnormal forms, and particularly to groups of cells at the apexes of certain archegonia for which up to the present no adequate interpretation has been suggested.

*The Enzyme-secreting Cells in the Seedlings of Zea Mais and Phœnix dactylifera:* Howard S. Reed.

During the process of germination, the above-named seedlings produce an enzyme for the solution of endosperm. The enzyme is secreted from a differentiated layer of cells. These cells show continuous morphological changes during the time the enzyme is being secreted. When secretion begins the cells of the secreting layer are full of the fine proteid granules, which are thought to be zymogen, because, as secretion progresses, they constantly disappear. In the early stages of secretion the nuclei of the secreting cells of *Zea Mais* are found in the basal end of the cell; in the later stages they are in the apical end next the endosperm layers. As secretion progresses, there is a continuous increase in the amount of chromatin in the nuclei of the secreting cells. At the same time the nucleoli decrease in size and staining properties. At the end of the process the protoplasm of the secreting cells breaks down and the products of disintegration disappear from sight.

*Discoid Pith in Woody Plants:* F. W. Foxworthy.

Discoid Pith: Any pith which is interrupted at frequent and tolerably regular intervals by transverse partitions dividing the pith up into a series of chambers. These partitions, disks, diaphragms, plates or lamellæ, as they are variously called, may be composed either of thick-walled or of thin-walled cells, and the spaces between the disks may be empty or filled with cellular tissue. Thus, M. Gris classifies discoid pith as: (1) Heterogeneous continuous diaphragmatic, when the pith is continuous between the disks, and (2) heterogeneous discontinuous diaphragmatic, when the pith is not continuous between the disks, but the interspaces filled with air. The first type of pith is found in *Liriodendron, Magnolia* species, *Asimina, Nyssa,* etc., and the cells forming the disks are very thick-walled and heavily lignified, while the cells forming the interspaces are small, very thin-walled and empty. The second type is found in *Juglans, Pterocarya, Celtis, Halesia, Forsythia viridissima, Jasminum* species, *Paulownia,* etc., and the cells forming the disks are thin-walled, empty and often shrunken. Discoid pith seems to be of taxonomic importance for generic distinctions in some

cases; though the characters it furnishes may be of only specific rank, as in *Forsythia* and *Jasminum*.

*A Plea for the Preservation of Our Wild Flowers:* C. E. Bessey and S. Coulter.

Cultivated flowers are planted and cared for by man, but no one cares for the wild beauties of the woods and meadow. We must preserve them. It is our privilege as lovers of plants to care for them and to see that they are not exterminated. The rarer the plant the greater the danger that it will be eradicated. Who are the offenders? The tourists, who lay their vandal hands on everything pretty; the amateurs, who desire to have samples of everything; and some botanists who think more of collecting specimens than of the beauties of nature in the field. At Colorado Springs the once beautiful Cheyenne Canyon has been made barren by the vandals, and there is scarcely a fern or a pretty flower now left in it. What shall we do about it? First of all let us talk vigorously against this vandalism. Talk in season and out of season, and denounce the wholesale destruction of wild flowers in the strongest language possible. Then write against vandalism. Do not fail to say what you think through the public press. The newspapers will help you every time if you call upon them. Then organize clubs and guilds and societies. Do this as you please. If you prefer to form a local chapter of the Wild Flower Preservation Society well and good. We shall take great pleasure in helping you. But if you prefer to form an independent club—do so by all means. It is not how you do it; it is only that you do something. Agitate the matter persistently and vigorously, and keep at it. In this way, only, may we hope to save our attractive wild flowers from extinction.

*Type of the Genus Agrostis:* A. S. Hitchcock.

In view of the fact that stable generic nomenclature depends upon the method of fixing the type of each genus, investigations concerning the effect of various rules upon different genera must be carefully worked out. For this reason the history of the grass genus *Agrostis* is presented. The effect of the application of different rules will be shown.

*The Morphology of Elodea Canadensis:* R. B. Wylie.

The pistillate flower is strongly epigynous, the fused parts of the flower forming a long floral tube which extends from the sessile ovary to the surface of the water. The stamens each bear two sporangia and the staminate flowers at maturity break loose from the stem and rise to the surface of the water. The rise of these flowers is aided by bubbles of oxygen. Though the pollen grains are heavier than water, the multitudes of spines on the exine hold back the surface film, thus imprisoning enough air to keep the spores afloat. The male cells, which are formed in the pollen grains, are very large, and during their continuance in the spores remain joined together. The pistillate flower opens upon reaching the surface of the water and the stigmas soon recurve, arching out over the floral parts. Since the stigmas are impervious to water, the weight of the flower resting on them forms a depression in the surface film. Pollen grains floating near are now attracted to the flower by gravity, operating through the declined surface film. They approach and drop into this depression in contact with the stigmas. In the development of the embryo-sac, four megaspores are usually formed, though six were noted in one instance. The embryo-sac at the two-celled stage develops an antipodal pouch, in which the antipodal group of nuclei is formed. The pollen tube shows a marked development. Its

course is down the floral tube, thence directly through the ovarian cavity to the upturned micropyles of the ovules. The pollen tubes that have failed to enter ovules often swell up at their tips into tuber-like enlargements, which may be fifteen times the normal diameter of the tube. In these tubers which lie among the ovules, the male elements can be made out, each distinctly a cell, rather than a nucleus only. About each male nucleus, which usually shows a nucleolus, is an ample cytoplasm bounded by a membrane. The functioning pollen tubes pass through the micropyle and seem to enter one of the synergids. Numerous preparations showed one sperm in contact with the egg nucleus, and in several instances the second sperm was found fusing with the endosperm nucleus. The egg regularly divides before the primary endosperm nucleus. The functioning pollen tubes persist for a long time, sometimes until the embryo is well developed.

*Prothallia of Botrychium obliquum:* H. L. LYON.

During the summer of 1903 gametophytes of *Botrychium obliquum* were collected in considerable numbers in Minnesota. In shape they resemble those of *B. Virginianum* but average only about one third the size of the latter. The reproductive organs are borne dorsally and do not differ essentially from those of other Ophioglossaceæ described. The embryo sporophyte is bipolar instead of tripolar as in *B. Virginianum,* the stem growing directly upward and the root directly downward through the prothallium. There is no pronounced nursing-organ. All the superficial cells of that portion of the embryo lying within the tissue of the gametophyte apparently act as absorbent cells. The primary root usually protrudes 1 to 3 cm. from the prothallium before the first leaf bursts through the calyptra.

*The Life History of Ephedra trifurca:* W. J. G. LAND.

Material for a morphological study of *Ephedra trifurca* was obtained in the vicinity of Mesilla, N. M. Collections were made at regular intervals between December 20, 1902, and May 20, 1903. The primordium which gives rise to the staminate flowers was apparent in the first material collected. The perianth appeared a month later. The primary wall cell divides to form two layers, the wall cell and the tapetum. The microspore mother cells remain in the resting condition about one month. The reduction division occurs about March 15. The gametophyte number of chromosomes is twelve. The male gametophyte at the time of the shedding of the pollen grain consists of two prothallial cells, tube nucleus, stalk cell and body cell. The body cell divides shortly before fertilization occurs. The ovule has two integuments: an outer one resulting from the fusion of four bracts, the inner one from the fusion of two bracts. The megaspore mother cell appears about March 8. Sometimes two or three megaspore mother cells are present, but only one megaspore functions. As the result of the division of the megaspore mother cell a row of four or sometimes three megaspores is formed, the lowest one being of course functional. The division of the megaspore is followed by free nuclear division and parietal placing. At least 256 nuclei are formed before walls appear. One, two or three archegonia are formed, and the central cell is placed deeply in the tissues of the gametophyte. The ventral nucleus is cut off shortly before fertilization, which occurred the present year about April 20. The oospore forms from two to eight free nuclei, each one of which organizes a wall and gives

rise to an embryo. The normal number of free nuclei is in general four. The single suspensors are very long and thrust the embryos deeply into the endosperm. Only one of the embryos develops.

*The Effect of Chemical Irritation upon the Respiration of Fungi:* Ada Watterson.

These experiments concerning the effect of chemical irritation upon the respiration of fungi were carried on with the Kunstmann and with the Pettenkofer forms of apparatus. The fungi used were *Sterigmatocystis nigra* and *Penicillium glaucum,* and the irritants were $ZnSO_4$, $FeSO_4$ and LiCl. The results go to show that although the economic coefficient of the sugar is increased, yet the $CO_2$ respired by the fungus remains proportionally the same.

*The Dehiscence of Anthers by Apical Pores:* J. A. Harris.

The author presents a systematically arranged descriptive list of all genera in which the dehiscence of the anthers is by apical pores, and makes a series of comparisons of the floral structure of these forms with other members of the same family, showing the modifications in not only the stamens, but the other floral parts as well, upon the assumption of the apically dehiscent habit. The forms are divided into groups or 'types' on structural grounds and the ecological relations of these considered. While the types as a whole are not sharply limited, a pronounced similarity of form in the corresponding parts of the different genera is observable even when these belong to systematic groups differing widely in floral habit. For some of these types the geographical distribution of the genera and species has a similarity which does not seem to depend on systematic relationships. The only explanation which seems possible is that of the somewhat similar distribution of the Apidæ, upon which their structure indicates they are largely dependent for pollination.

Francis E. Lloyd,
*Secretary.*

## *GEOGRAPHY IN THE UNITED STATES. II.*

It has been maintained that one of the embarrassments from which geography suffers is the incoherence of the many things that are involved in its broad relationships. This is not really a serious embarrassment, and so far as it is an embarrassment at all it is not peculiar to geography. It is not a serious embarrassment, because when any element of geography is treated in view of the relations into which it enters, it becomes reasonably interesting to all who are concerned with scientific geography. The embarrassment is not peculiar to geography, for it is found in all other studies; in history, for example, where an essay by a specialist on the modern history of South America is not likely to excite an enthusiastic interest in the mind of the student of classic times in Greece, or in the mind of the student of medieval church history in Germany; the embarrassment is known also in geology, where the student of the petrography of the southern Appalachians, or of the paleontology of the Trias in California, may care little for a paper by a colleague on the glaciation of the Tian Shan Mountains in Turkestan. Yet, however unlike these various topics in history or in geology may be, they are welcomed, if well treated, by all the members of the expert society or by all the readers of the special journal in which they are presented, because they so manifestly make for progress in the science to which they belong. Geographers need not, therefore, be embarrassed on finding discussions of magnetic declination as affecting the navigation of the antarctic re-

gions, of the relations of climate and religion among the Hopi amerinds, and of the facilities for irrigation peculiar to aggrading fluviatile plains, all in one journal; this diversity of topics only illustrates the great richness of geography, and thus likens it to history and geology.

Let me consider next the advantages that will come to geography from the systematic collection and classification of all the facts pertinent to it. The popular idea of geographical research is fulfilled when an explorer discovers a new mountain or a new island; but discovery is not enough. The thing discovered must be carefully described in view of all that is known of similar things, and the relation into which the thing enters must be sought and analyzed. Careful work of this nature involves the development of systematic geography, in which all items of a kind are brought together, and all kinds of items are arranged according to some serviceable scheme of classification. Geographers are far behind zoologists and botanists in this respect, for there is to-day no comprehensive scheme of geographical classification in general use. Existing schemes are too generally empirical and incomplete. So important a group of land forms as mountains has never yet been thoroughly treated in a physiographic sense, while the organic responses to inorganic controls are as a rule not classified by geographers at all; yet a comprehensive scheme of classification should certainly provide systematic places for the organic responses as carefully as for inorganic controls. In the absence of a generally accepted scheme of classification, it is natural that items of one kind and another should be neglected in text-books and elsewhere; for it is well known that incompleteness of treatment goes with unsystematic methods. So simple and manifest a response to the globular form of the earth as is afforded by a wide extent of modern commerce is seldom mentioned in connection with its control. The many important and interesting responses to the eternal and omnipresent force of gravity are not habitually treated as geographical topics at all; nor is the definition of boundaries in terms of meridians and parallels usually recognized as a response that civilized nations now habitually make to the form and rotation of the earth, when they have occasion to divide new territory in advance of surveys and settlement. Yet surely all these responses to environment deserve systematic mention when the earth is described as a rotating, gravitating globe, just as the location of villages and the growth of cities at some point of advantage to their inhabitants deserve mention in the pages given up to geography of the more conventional kind. The development of a well-tested scheme of systematic geography may, therefore, be urged upon every geographer as a problem well worthy of his attention. A practical step toward the construction of such a scheme is evidently the accumulation of items that call for classification; therefore, let the geographer study the world about him: and a most effectual aid in the accumulation of items is found in searching for the organic response to every inorganic control, and for the inorganic control of every organic response that comes to one's attention; therefore, let the geographer think carefully as he looks about him over the world. It can hardly be doubted that the explorer who goes abroad or the student who stays at home will make better progress in his investigations in proportion to the completeness of the systematic scheme with respect to which he consciously carries on his work. I would, therefore, urge the development of the habits of always associating causes with their consequences and consequences with their causes, and of always referring both

causes and consequences to the classes in which they belong. If to these two habits we add a third, namely, that of making a careful arrangement of the classes in a reasonable and serviceable order, we shall have taken three important steps in geographical progress, and, as a result, geography will flourish.

There is no device by which the work of the specialist is so helpfully relieved of its narrowing influence as by the simple device of looking always for the general geographical relations of any special topic. The specialist in the geographical study of ocean currents, of caverns or of deltas, of forests, of trade routes or of cities, should not lessen his attention to his chosen line of work, but he should, often to his great advantage, increase his attention to the place that his chosen subject holds in the whole content of geography. Not only will his work be broadened in this way, but both he and his work will be brought into closer relations with the whole body of geographers and the whole content of geography, and the possibility of organizing a society of mature geographical experts will be thereby greatly increased. If the geographical relations of a special topic are not looked for, the specialist fails to that extent of becoming a geographer. The climatologist who studies the physical conditions of the atmosphere for their own sake, the oceanographer who makes no application of the physical features of the ocean as controls of organic consequences, the geomorphist who is satisfied with the study of land forms as a finality, the student of the location of cities and the boundaries of states who makes no search for the explanation of his facts as affected by physiographic controls—these specialists may all be eminent in their own lines, but they fall short of being geographers. In the same way it might be shown that a petrographer who makes no study of field relations and discovers no results of processes and no sequences in time, fails of being a geologist, for geology deals essentially with processes and structures in time sequence; likewise a chronologist who is satisfied with mere dates of occurrence fails of being a historian, for history involves the meaning as well as the mere sequence of human events. There is, of course, no blame to be attached to interest in specialization, no praise to an interest in larger relations; it is merely a matter of fact that the isolated specialist remains somewhat to one side of the larger sciences with which he might become associated. On the other hand, the geographer is not necessarily so broad-minded that he must be shallow; he may specialize deeply on the climatologic, oceanographic, geomorphic, topographic, organic divisions of his subject; but if he wishes to be considered a geographer he should cultivate all the geographic relations into which the facts of his chosen division enters, and he will find that it is largely through these relations that he associates himself profitably with other geographers.

Two of the most beneficial results of the systematic study of geography are the great increase in the number of classes or types with which the geographer becomes familiar, and the great improvement in the definition of these types. This is particularly the case with those types which contain many individual examples, such as rivers and cities, and which are, therefore, capable of division into many headings. So long as the geographer deals only with things in an empirical fashion, he may be satisfied with a rough classification; as soon as he begins to treat his problems more carefully, his classification becomes more refined and he has relatively more to do with classes of things than with the things themselves. The things are actual, the classes are ideal, and therein lies one

of the greatest values of systematic geography; it enforces attention upon the idealized type; by means of this increased attention the type is more fully conceived, and both observation and description of actual things are greatly aided. Let me illustrate.

The breezes that descend from mountain valleys at night are well known and well understood phenomena. As a result, one may form a well-defined conception of such a breeze—a type mountain breeze—imagining its gradual beginning, its increase in strength with its extension in area, and its gradual extinction; all its phases of waxing and waning being duly related to the passing hours of the night and to the associated changes of temperature. It is safe to say that no actual mountain breeze is as well known by direct observation of all its parts and stages as is the type breeze, in which all pertinent observations are properly generalized, and in which the deficiencies of observation are supplemented as far as possible by inferences deduced from well-established physical laws. It is entirely possible that there may be some errors in the deduced elements of the ideal type-breeze, but it may be confidently asserted that the errors will be replaced by the truth through the methods involved in observing, imagining and checking, guided by the conception of the type, sooner than the truth will be discovered by blind observation unguided by the aid that a well-defined type affords.

It is the same with an alluvial fan; an element of land form that has, by the way, more similarity to a mountain breeze than appears on first thought. Observation shows only the existing stage of the surface of a fan; the fully developed type-fan includes the structure as well as the surface, the process and the progress of formation, extended into the future as well as brought forward from the past. There can be no question that the explorer who is equipped with a clear conception of a type-fan can do much better work in observing and describing the fans that he may find than will be done by an explorer who thinks he can dispense with all idealized types, and who proposes simply to describe what he sees. The shortcomings of the simple observational method would be less if it were not so difficult to see what one looks at and to record what one sees; but any one who has had experience in field studies knows how far short seeing may be of looking, and how far short recording may be of seeing. The best results in geographical investigation can only be obtained when every legitimate aid to observation and description is summoned; and of all aids, that furnished by carefully considered types, reasonably classified, is the greatest. When large and complicated features, such as valley systems or cuestas, are to be described, the need of types is vastly increased. Hence one of the most important and practical suggestions that can be made toward the maturing of geographical science is to cultivate the geographical imagination in the direction of acquiring familiarity with a large, systematic series of well-defined ideal types. As progress is made in this direction there will be profitable advance from that narrow conception of geography which is based on the school-day study of names, locations and boundaries—the only conception of geography that many mature persons in this country possess—to a wider conception in which everything studied is considered as an example of a kind of things, so that it shall appeal to the reasonable understanding rather than to the empirical memory. Progress of this sort is already apparent in the schools, but it has not yet reached a desirable measure of advance.

One of the best results that follow from the systematic recognition of a large num-

ber of well-defined types will be the natural development of an adequate geographical terminology. When review is made of modern geographical articles it is curious and significant to find only a small addition to the school-boy list of technical terms. This is not true of any subject that is cultivated in the universities as well as in the schools. It is a reproach to geography that the results of mature observation are so generally described in the inadequate terms of immature study; this reproach will have the less ground the more thoroughly systematic geography is studied. With the development of more mature methods of description there may come a larger share of attention to the thing described, and thus a relative decrease of attention to matters of merely personal narrative. I do not wish to lessen the number of entertaining books of travel which now fill many of the shelves in libraries called geographical, but it would be a great satisfaction to see the standard works of geographical libraries given a more objective quality, so that they might compare favorably with the standard works of geological or botanical libraries, in which the element of personal narrative is reduced to its properly subordinate place.

Another step of equal importance with the establishment of geographical types is the change from the empirical to the explanatory or rational or genetic method of treating the elemental facts that enter into geographical relationships. The rational method has long been pursued in regard to the facts of the atmosphere and the ocean; it is coming to be adopted for facts concerning the lands; and since the adoption of an evolutionary philosophy, the evolutionary explanation of the organic items of geography may replace the teleological treatment that obtained in Ritter's time. It is, however, very seldom the case that geographers adopt the rational method consciously and fully; hence special attention to this phase of the theoretical side of geography may be strongly urged. It may be noted in this connection that the application of the explanatory method has been so lately made to the treatment of land forms that the geographer may for the present make himself to his advantage something of a specialist in this branch of the subject. It should be added that, so long as he studies land forms in order better to understand the environment in which living things find themselves, he remains a geographer and does not become a geologist. There is a needless confusion in this matter, which may, perhaps, be lessened if its untangling be illustrated by the following geological comparison.

For some decades past a new method of treatment has been applied to the study of rocks, greatly to the advantage of geologists. The method requires a good knowledge of inorganic chemistry and of optical physics, and the geologists who have specialized in the study of rocks have had to make themselves experts in these phases of physics and chemistry; but they are not for that reason classified as physicists or chemists. They remain geologists, though sometimes taking the special title of petrographer. So with the geographer who specializes in the study of land forms; he must make himself familiar with certain phases of geology, but he does not, therefore, become a geologist; he remains a geographer. His object is not to discover for their own sake the past stages through which existing land forms have been developed; he studies past forms only in order to extend his knowledge of systematic physiography and thus to increase his appreciation of existing forms. As far as he studies the sequence of past forms he is studying a phase of geology, just as the geologist who examines existing arrangements of climate, of oceanic circulation, or

of land forms, is studying a phase of physiography. The two sciences are manifestly related, but they need not be confused. For, as has been shown for sciences in general, geology and geography are best characterized by the relations in which their topics are studied, and not by the topics themselves. Both are concerned with the earth and life. The whole content of knowledge concerning the earth and life might be shown by a cube, in which vertical lines represented the passage of time, and horizontal planes represented phenomena considered in their areal extension; then if the whole mass of the cube were conceived as made up of vertical lines, that would suggest the geological conception of the whole problem; while if the cube were made up of horizontal planes, that would suggest its geographical aspect; and the whole series of paleogeographies, horizontally stratified with respect to the vertical time line, would culminate in the geography of to-day.

Objection is sometimes made to the plan of geography, as here set forth, that it involves hypotheses and theories, instead of being content with matters of fact, as the advocates of a more conservative method in geography suppose themselves to be. There is no doubt that geographical investigation of the kind here exposed does involve abundant theorizing, but that is one of its chief merits, for therein it adopts the methods of all inductive sciences. Furthermore, as between the progressive geographer, who candidly recognizes that he must theorize, and the conservative geographer, who thinks that he observes facts only and lets theories alone, the chief difference is not that the first one theorizes and the second does not, but that the first one knows when he is theorizing and takes care to separate his facts and his inferences, to theorize logically, to evaluate his results, while the second one theorizes unconsciously and hence uncritically, and, therefore, fails to separate his inferences sharply from his facts, and gives little attention to the evaluation of his results. Geography has, indeed, suffered so long and so seriously from the failure of geographers to cultivate the habit of theorizing as critically as the habit of observing—studies of the atmosphere and the ocean still excepted, as above—that a strong recommendation must be given to the acquisition of the methods of theoretical investigation, in which deduction is an essential part, by every one who proposes to call himself a scientific geographer. Let me give an example of the loss of time that has resulted from the failure of geographers to develop the habit of theorizing.

For forty years past there has been active discussion as to how far land forms in glaciated regions had been shaped by glacial erosion, but not till within five years has any geographer clearly defined the deductive side of this problem. In order to determine whether land forms are carved by glacial erosion or not, two methods have been open: one is to observe the action of existing glaciers and thus determine whether they are competent or not to carve land forms; but this is difficult, because the beds on which glaciers lie can not be well examined. The other method is to deduce the appropriate consequences of both the affirmative and the negative suppositions, and then to confront these consequences with the facts found in regions once glaciated, and see which set of consequences is best supported. This deductive method is very simple. Its application involves no principle that was not perfectly well known fifty years ago, though it does involve a facility in theorizing that does not seem to have been familiar or habitual with geographers until more recent times. On the supposition that gla-

ciers do not erode, the valley systems of once glaciated mountains ought not to exhibit any significant peculiarity of form, but should correspond to the normal stream-worn valley systems of non-glaciated mountains. On the supposition that glaciers do erode, the valley systems of once glaciated mountains should exhibit the highly specialized feature of a discordant junction of branch and trunk; for the channels eroded by a small branch glacier and by a large trunk glacier must stand at discordant levels at their junction, just as the channels of a small stream and a large river do, though the measure of discordance is much greater in the channels of the clumsy, slow-moving ice-streams than in the channels of the nimble, quick-moving water-streams. There can be no question that these well-specialized consequences, deduced from the postulate that glaciers can erode their channels, are much more accordant with the actual features of valley systems in once glaciated mountains than are the consequences deduced from the opposite postulate; but my reason for introducing this problem here is not to call attention to the value of 'hanging valleys' in evidence of glacial erosion, as first clearly set forth by Gannett in 1898 in his account of Lake Chelan, but rather to point out how slow geographers have been to employ the deductive method in solving this long-vexed problem. The moral of this is that geographers as well as geologists, physicists, astronomers, ought to have good training in scientific methods of investigation, in which all their faculties are employed in striving to reach the goal of full understanding, instead of depending so largely on the single faculty of observation.

Some may, however, object that the problem of glacial erosion, just touched upon, belongs exclusively to geology, and not at all to geography. It belongs to both; its association will be determined by its application, as the following considerations will show. The accumulation of sand-dunes by wind action, the abrasion of sea-coasts by waves, the erosion of gorges by streams, the construction of volcanoes by eruptions now in progress, manifestly belong in the study of physical geography, in close association with the blowing of the winds, the rolling of the waves, the flowing of streams, and the outbursting of lavas and gases. Both the agent and the result of its action are elements of the environment by which life is conditioned. Similarly, the grass-covered dunes of Hungary, the elevated sea-cliffs of Scotland, the abandoned gorges of central New York, and the quiescent volcanoes of central France, are all elements of land forms and are all treated as geographical topics and explained by reference to their extinct causes in the modern rational method of geographical study. Likewise the discordant valley systems of glaciated mountains are proper subjects for explanatory treatment in the study of geography, although the glacier systems that eroded them are extinct; they deserve explanatory treatment in geography just as fully as do the accordant valley systems of non-glaciated mountains. It is true that discussion as to whether certain sculptured land forms are due to glacial erosion is likely to continue more or less actively through the present decade; but when this problem is as well settled as the problem of stream erosion has already been, the geographer will be content with the simplest statement of the evidence that is essential to the conclusion reached; and the explanatory descriptions of land forms will include due reference to forms of glacial origin, just as much as a matter of course as they now include reference to forms of marine or of subaerial origin. Forms of glacial sculpture will be given as assured a place in

geographical study as forms of glacial deposition are already given. Neither the thing studied, nor the agent by which it was produced, nor the method by which the agent is shown to be accountable for the thing, suffices to show whether the thing is of a geological or a geographical nature. This question will be decided, as has already been shown, by the relations into which the thing enters. It would be as unreasonable to omit all reference to glacial erosion in a geographical description of Norway as to omit all reference to subaerial erosion in a geographical account of our Atlantic coastal plain.

Nowhere is the cultivation of systematic geography more helpful than in the study of local or regional geography. The truth of this may be appreciated by considering the case of botany. No botanist would attempt to describe the flora of one of our states until he had obtained a good knowledge of systematic botany in general. Such knowledge would help him at every turn in his study of a local flora, not only in describing the plants that he might find, and in arranging the descriptions in a serviceable order, but also in finding the plants themselves. I believe that a closely equivalent statement might be made with regard to the geography of a state; and yet there is not, to my knowledge, a single work on regional geography in which a recognized scheme of systematic geography has been avowedly followed as a guide for the treatment of local features. The adoption of such a guide would lead to various advantages; on announcing that a certain scheme of systematic geography has been chosen as a standard, the writer of a regional work thereby gives notice in the simplest manner to the reader as to the kind and amount of knowledge necessary to understand the work in hand; descriptions are made at once briefer and more intelligible than by phrasing them in terms of a scheme that is elsewhere stated in full; relative completeness of treatment is assured, for with a systematic list of all kinds of geographical relations at hand, the writer is not likely to overlook any element of the subject that occurs within his chosen region; the reader can easily find any desired topic, not only by means of the table of contents and index, but also by means of the standard scheme of classification in accordance with which all elements are arranged; and finally, books on different regions will come to exhibit a desirable uniformity of treatment when they are based on a common scheme of systematic geography. Although no books of this kind now exist, I do not think it overventuresome to say that some such books will soon exist, and that they will form very serviceable contributions to the literature of our subject.

The various recommendations that I have made are likely to remain in the air, or at most to secure response only from isolated individual students, unless those who believe that the adoption of these recommendations would promote the scientific study of geography are willing to give something of their time and thought toward organizing a society of geographical experts—an American geographers' union. From such a union I am sure that geography would gain strength, but it is not yet at all clear in my mind that any significant number of persons would care to accept the strict conditions or organization which appears to me essential for the success of such an enterprise. The most important of the conditions are as follows:

1. The adoption of some definition for geography that shall sufficiently indicate the boundaries as well as the content of this broad subject.

2. The limitation of membership to persons with whom geography as thus defined is a first or at least a second interest, and

by whom more than one geographical article of advanced grade, based on original observation and study, has been published.

3. The independence of the union thus constituted of all other geographical societies.

Although we can not adduce any existing geographical society in this country as a witness competent to prove that geography has sufficient unity and coherence to tempt geographers to form such a union as is here contemplated, a careful review of the problem convinces me that a sufficient unity and coherence really exist in the science as I have treated it; and I, therefore, believe that the formation of an American geographers' union is feasible as well as desirable.

It has been my object in this address to describe briefly the status of mature geography in our country, and to suggest several steps that might be taken for its improvement. Certain branches of the subject have reached a high development, but the subject as a whole does not thrive with us. The reason for its relative failure is not, I believe, to be found in the very varied nature of its different parts, but rather in the failure to place sufficient emphasis on those relationships by which, more than by anything else, geography is to be distinguished from other sciences, and by which, more than by anything else, geographers may come to be united. Among the great number of persons—many thousands in all—whose attention is given primarily to subjects that are closely related to geography as here defined, there must certainly be many—probably several hundred—with whom mature geography is a first interest. It is upon these persons, geographers by first intention, that the future development of sound and thorough, mature and scientific, geography among us primarily depends. To these geographers, in particular, I would urge the importance of developing the systematic aspects of the science, and of constantly associating the special branch that they cultivate with the subject as a whole. Observation will not suffice for the full development of geography; critical methods of investigation, in which deduction has a large place, must be employed; for only by the aid of careful theorizing can an understanding of many parts of the subject be gained. With the progress of systematic geography we may expect to see a parallel progress of local or regional geography. As the science is thus developed, societies of mature geographical experts will be formed, and scientific geography will thrive; but whether thus developed into a thriving science or not, I hope that another long term of years may not pass without a representative of geography in this vice-presidential chair.

W. M. Davis.

Harvard University.

## *KARL ALFRED VON ZITTEL.*

In the death of Karl Alfred von Zittel paleontology has lost one of its most distinguished advocates. Although a German by birth, Professor von Zittel belonged to every country, and through his remarkable work 'Handbuch der Palæontologie' his influence extended everywhere. It is probably not an exaggeration to say that he did more for the promotion and diffusion of paleontology than any other single man who lived during the nineteenth century. While not gifted with genius, he possessed extraordinary judgment, critical capacity and untiring industry.

The first volume of his great work bears the date 1876–1880, covering the extinct Protozoa, Cœlenterata, Echinodermata and Molluscoidea; the second volume, covering the Mollusca and Arthropoda, bears the date 1881–1885; the third volume, beginning the Vertebrata, was issued between 1887 and 1890, and covers the Pisces, Am-

phibia, Reptilia and Aves; the fourth volume, issued between 1891–1893, is devoted to the fossil mammalia. Under his editorship appeared also the second part of the great 'Handbuch,' including the 'Palæophytologie' begun by Schimper and continued and concluded by Schenk, and issued in 1890.

These volumes, which together number 4,315 pages, are richly illustrated and admirably indexed, and constitute a veritable encyclopedia of paleontology.

Immediately after the completion of this work the author began the preparation of a condensed treatise upon the whole subject, entitled 'Grundzüge der Palæontologie,' which was issued in 1895, consisting of 950 pages. A second revised edition has just appeared (1903).

We mention this monumental work first, because it was chiefly through this that the influence of von Zittel was exerted. The prodigious progress of paleontology in the nineteenth century was scattered through thousands of monographs and special papers, a hopeless labyrinth to the student, and an extremely difficult field even to the expert investigator; it had ceased to be possible to gain a perspective view of the whole subject, not to speak of the difficulty of mastering the details. With remarkable clearness and fullness, with impartial justice to workers in every country, with especially warm appreciation of the work done in America, von Zittel devoted himself for twenty years to this great task. I had the privilege of studying with him in Munich while he was engaged on the volume on the mammalia, and I was greatly struck with his extremely effective and comprehensive methods of work, which he carried on while giving a full and delightful course of lectures on the same subject.

This, however, was only one form in which von Zittel's influence was exerted. He established a great historical collection in the Alte Akademie of Munich, in which he gathered from all parts of the world collections illustrating the evolution of plants and of invertebrate and vertebrate animals. Here are to be found not only fossils from all parts of Germany, but rare collections from Pikermi and Samos, from the French Tertiaries, especially the phosphorites, from North America, including especially a remarkable collection of Cretaceous fossils made for him by Charles H. Sternberg, as well as a valuable collection of Permian fossils made by Dr. Broili, Mr. Sternberg and others. In addition to these there are remarkably fine specimens secured by exchange and purchase from the Tertiaries of North America, from the Oligocene. The same clear judgment which was displayed in the 'Palæontologie' is evidenced in the arrangement of this vast collection, so that nowhere else in the world can a student follow with equal ease the whole story of the evolution of life.

It is small wonder that Munich became the Mecca of paleontologists, young and old. Professor von Zittel had an exceptionally charming and magnetic personality. His face was full of keen intelligence and enthusiasm. He took the deepest interest in the original researches of young men who came to him from various parts of the world, and was unusually generous in placing in their hands much of his rarest material; in fact, the memoirs which were published under his supervision far outnumber those which he was able to publish himself, because of his long-continued devotion to his preparation of the 'Handbuch.' He occupied a position in paleontology similar to that occupied by the lamented Gegenbaur in comparative anatomy. Among his pupils may be numbered, with a few exceptions, all the younger American, most of the German, and many of the younger French and Austrian paleontologists. All bear him in

most grateful remembrance and will sadly mourn his loss.

The following details of his life are taken from one of the newspaper notices of his death. He was a son of Karl Zittel, the leader of the Clerical Liberals in Baden, and was born at Bahlingen, near Freiburg, on September 25, 1839. He studied at Heidelberg, Paris and Vienna. After serving as assistant in the Hofmineralien-Kabinet in Vienna, he was appointed professor of mineralogy at Karlsruhe, and in 1866 he assumed the same professorship in Munich, where he also became director of the Paleontological Staatsmuseum. The great scientific value of the Rohlf expedition to the Libyan desert in 1873–74 was owing chiefly to his participation in it. He wrote a book on the expedition; another on the Sahara, and many treatises on geological and paleontological subjects. In 1899 he published his 'Geschichte der Geologie und Palæontologie'—an important work carrying the subjects to the end of the nineteenth century. He was editor of the periodical *Palæontographica*. He was present at the opening of the Northern Pacific Railroad in August and September, 1883. It may be added that he had been in delicate health for some years. His death was unfortunately hastened by his being struck by a bicyclist, causing a serious injury to his knee and a long and debilitating confinement.

He traveled extensively. Aside from the special journey to the United States in connection with the Northern Pacific Railroad, he came here again in connection with the meeting of the International Geological Congress, visiting all the American museums and studying the great collections with most intense interest. At the meeting of the Geological Congress in Paris in 1900, Professor von Zittel received the honors to which he was so richly entitled, frequently presiding over the paleontological and geological sections.

HENRY FAIRFIELD OSBORN.

## SCIENTIFIC BOOKS.

*The Moth Book. A Popular Guide to a Knowledge of the Moths of North America.* By W. J. HOLLAND. New York, Doubleday, Page & Company, 1903. Pp. xxiv + 479. Forty-eight plates in color photography and numerous illustrations in the text.

All persons interested in the study of Lepidoptera, including hundreds of amateur collectors, have anxiously been awaiting the publication of Dr. Holland's 'Moth Book,' which was promised five years ago in the introduction to his well-known and very useful 'Butterfly Book.' The volume has now appeared, and will be a delight to collectors and will greatly facilitate their attempts to determine their specimens, and will no doubt induce many others to take up the study of these beautiful and interesting insects. In his 'Butterfly Book' Dr. Holland had a restricted group of comparatively few species, and was able to illustrate or describe practically every species known to occur within the limits of the United States. The task of producing a serviceable moth book has been much more difficult. To illustrate and describe all of the thousands of species of moths of this country would require the publication of several volumes. Therefore, an effort has been made to select those species which adequately represent the various families and the commoner and more important genera, thus providing a work which will serve as an introduction to the study. The selection has been admirable. The 48 colored plates illustrate with beautiful accuracy more than 1,500 species, and all through the text are illustrated other species to the number of more than 250. Dr. Holland adopts in the main the classification of Sir George Hampson, and uses 43 family names. In nomenclature he wisely follows, for the most part, Dr. Dyar's list of the Lepidoptera of the United States, and has conformed the text of his volume to Dr. Dyar's serial arrangement. Dr. Holland differs, as he says, from Dr. Dyar

in his views as to the position which should be held in relation to each other of a number of genera, but as Dyar's list is certain for many years to come to be used largely by American students in arranging their collections, he has thought best to follow it. As in the 'Butterfly Book,' the 'Moth Book' contains a number of digressions and quotations. The quotations are extremely apt, and the digressions are extremely readable.

Dr. Holland's literary style is charming, and his cosmopolitan training and wide range of information lend interest and value to every line of the digressions. The one entitled 'Walking as a Fine Art' deserves a place in literature as well as in a treatise on hygiene. The book is by no means confined to descriptive matter of the species treated. Statements concerning the habits and the life histories are scattered through the pages, and much sound information of a practical economic character accompanies the accounts of many of the injurious species. The general chapters on the life history and anatomy of moths, and on the capture, preparation and preservation of specimens, contain all the information that is necessary, and in the chapter entitled 'Books about the Moths of North America' the author has given a competent bibliography for the use of students who wish to go further into the subject. The index is very full.

As a bit of book-making, the volume is a handsome one. Some of the text figures suffer in the printing on account of the character of the paper used, but this is by no means a serious blemish.

Dr. Holland is to be congratulated on the completion of this very attractive and useful work, and the number of collectors and students is sure to be increased rapidly as the result of its publication. L. O. HOWARD.

*Allgemeine Physiologie. Ein Grundriss der Lehre vom Leben.* By MAX VERWORN. Fourth Edition, revised. Jena, G. Fischer. 1903. Pp. 652; illustrations 300.

The favor with which this work is still regarded is evinced by the fact that the fourth edition is now called for within nine years of the book's first appearance. The author has made in it less radical changes than in previous editions. Those portions which have received the most considerable alterations are the section on 'Physical World and Mind,' which has been rewritten and enlarged, and endeavors to present more clearly than before the author's psychomonistic conception; the section on 'Enzymes and Their Mode of Action,' which has again been rewritten, largely for the purpose of showing the analogy between ferment actions and the catalytic actions of inorganic chemistry; and the section on 'Growth as the Fundamental Phenomenon of Change of Form,' which has been revised and extended by Professor Rhumbler, and contains the latest conclusions of that well-known investigator, with figures and discussions of Rhumbler's and Heidenhain's models of the dividing cell. In the revision of the chemical portions of the book the author has had the counsel of Professor von Baeyer, of Munich, and Dr. Coehn, of Göttingen, and the alterations, though not great, represent improvements.

Engelmann's law of complementary chromatic adaptation is cited, according to which the color of an organism becomes more and more complementary to that of colored light to which the organism is subjected. Macfadyen's observations are summarized on the resistance of bacteria to extreme cold, and Regnard's observations of the temporary cessation of vital activity in a large variety of organisms subjected for not too long a time to great pressure. Wallengren's demonstrations are quoted of anodic, kathodic and transverse galvanotaxis in the same organism by the application, to the same spot, of polar stimuli of different intensities. Many other recent discoveries are cited; but with the multiplicity of present investigations in general physiology one naturally finds many important omissions. By judicious excisions and condensations of the previous text the enlargement of the book, caused by the additions and a much-needed revision of the index, is limited to twenty-one pages.

FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

*SCIENTIFIC JOURNALS AND ARTICLES.*

*The Journal of Infectious Diseases*, Volume I., No. 1.

Frederick G. Novy and Ward J. McNeal: 'On the Cultivation of *Trypanosoma Brucei*.'

Louis B. Wilson and William M. Chowning: "Studies in *Pyroplasmosis Hominis* ('Spotted Fever' or 'Tick Fever' of the Rocky Mountains)."

John R. McDill and William B. Wherry: 'A Report on Two Cases of a Peculiar Form of Hand Infection due to an Organism Resembling the Koch-Weeks Bacillus.'

H. Gideon Wells and Lee O. Scott: "The Pathological Anatomy of 'Paratyphoid Fever.'"

George H. Weaver: 'Agglutination of Streptococci, Especially Those Cultivated from Cases of Scarlatina, by Human Sera.'

Gustav F. Ruediger: 'The Effects on Streptococci of Sera of Cold-blooded Animals.'

Wilfred H. Manwaring: 'The Action of Certain Salts on the Complement in Immune Serum.'

Milton M. Portis: 'Experimental Study of Thyrotoxic Serum.'

Alfred Scott Warthin and David Murray Cowie: 'A Contribution to the Casuistry of Placental and Congenital Tuberculosis.'

C.-E. A. Winslow and D. M. Belcher: 'Changes in the Bacterial Flora of Sewage During Storage.'

S. C. Prescott and S. K. Baker: 'On Some Cultural Relations and Antagonisms of Bacillus Coli and Houston's Sewage Streptococci; with a Method for the Detection and Separation of These Microorganisms in Polluted Waters.'

The opening (January) number of volume 5 of the *Transactions of the American Mathematical Society* contains the following papers:

L. E. Dickson: 'The Subgroups of Order a Power of 2 of the Simple Quinary Orthogonal Group in the Galois Field of order $p^n \equiv 8l \pm 3$.'

J. G. Hun: 'On Certain Invariants of two Triangles.'

Edward Kasner: 'Isothermal Systems of Geodesics.'

A. Loewy: 'Zur Gruppentheorie mit Anwendungen auf die Theorie der linearen homogenen Differentialgleichungen.'

J. W. Young: 'On the Group of the Sign $(0, 3; 2, 4, \infty)$ and the Functions belonging to it.'

Saul Epsteen: 'On the Definition of Reducible Hypercomplex Number Systems.'

E. Goursat: 'A Simple Proof of a Theorem in the Calculus of Variations (Extract from a Letter to Mr. W. F. Osgood).'

*The American Naturalist* for November is a little belated. It contains the second of the papers on 'Adaptations to Aquatic, Arboreal, Fossorial and Cursorial Habits in Mammals,' this being by Louis I. Dublin on 'Arboreal Adaptations.' In a few instances it would seem that the writer may not have distinguished between physiological adaptation and morphological characters. D. T. MacDougal considers at some length 'Mutation in Plants,' some of his conclusions being that new types of specific rank have arisen in *Œnothera* by discontinuous variation, that natural selection is universally prevalent is certainly disproved and that nothing in the nature of living organisms demands that all species should have originated in the same manner. S. E. Meek presents a paper on the 'Distribution of the Fresh-Water Fishes of Mexico,' considering that four distinct fish faunas are present, and that their origin and number of species are as follows: From the Colorado River, 9; from the Rio Grande, 80; from the Lerma, 49; and from Central America, 246. The final paper, by Pehr Olssön-Seffer, is on the 'Examination of Organic Remains in Postglacial Deposits,' particularly in peat, and contains very good and full directions as to the methods and apparatus necessary.

*The Popular Science Monthly* for January has for a frontispiece a portrait of the late Herbert Spencer from a bust made when he was seventy-six. The first article is 'A Case of Automatic Drawing,' by William James, with numerous illustrations of the curious pictures made by the subject. In 'The College Course' John J. Stevenson makes a plea for a return to the college with a course of four years, mainly compulsory, and in 'The Functions of Museums' F. A. Bather suggests such a division of the material as would make it most available for the general student, the special student and the general visitor. T. A. Jaggar describes 'The Eruption of Pelé, July 9, 1902'; Allan McLaughlin discusses 'Immigration and the Public Health,' suggesting more carefully drawn laws on the subject, and Amanda Carolyn Northrop considers 'The Successful Women of America,'

being a study of those who appear in 'Who's Who in America.' Authors are in the great majority, and, save in science, those educated in private schools exceed in number those educated in public schools. D. D. Wallace presents the case of 'Southern Agriculture: Its Condition and Needs,' the latter being better trained labor, credit at reasonable rates and a more suitable education for his work. Wm. Scheppegrell describes 'Voice, Song and Speech,' and there is a reprint of Herbert Spencer's 'What Knowledge is of Most Worth?' 'The Progress of Science' contains a criticism of what the Carnegie Institution has not accomplished.

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## *SOCIETIES AND ACADEMIES.*

### THE ACADEMY OF SCIENCE AND ART OF PITTSBURG. SECTION OF BIOLOGY.

THE regular monthly meeting of the section was held on December 1, in the lecture hall of the Carnegie Institute. Doctor E. G. Matson, city bacteriologist of Pittsburg, discussed with the members, the germ theory and the zymotic theory of epidemic diseases; the discovery of bacteria, their form, structure and office in the economy of nature, evidence upon which rests the doctrine that they are the causes of diseases, the advantages of having the specific agents of these diseases for practical purposes, and at the same time the possibility of getting on without this knowledge; the individuality of contagion and the necessity of taking this into account in the attempt to prevent epidemics, such as smallpox, typhoid fever and yellow fever; how the bacteria make their attack; toxin, antitoxin and the immunity problem.

The malarial mosquito received some attention, and considerable valuable information was given regarding the epidemic of typhoid fever which has been raging for several weeks in Butler, Pa. There have been about 1,800 cases, with 84 deaths, representing a fatality of a little more than 10 per cent.

Many thousands of dollars have been generously contributed from various sources.

The infection of the water supply of the city seems to have been responsible for the general spread of the disease, two cases being discovered not far from the city's reservoir.

FREDERIC S. WEBSTER,
*Secretary-Treasurer.*

### WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS.

THE thirty-fourth annual meeting of the Wisconsin Academy of Sciences, Arts and Letters was held in the State Normal School Building in Milwaukee, Tuesday and Wednesday, December 29 and 30, 1903, President J. J. Davis in the chair. The program contained thirty-six titles, nearly every field of science being represented, although physical papers were entirely absent. Several excellent papers were presented upon philosophical, pedagogical and literary subjects. The program was notable in that so many sections of the state and so many different institutions were represented. The number of papers coming from the university, from the colleges and from the normal schools was nearly equal. Volume XIV., part 1, of the *Transactions* of the academy, containing fifteen papers, has just been published.

E. B. SKINNER,
*Secretary.*

### NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE 48th regular meeting of the section was held Friday, December 18, 1903, at 8 P.M., at the Tech Union, Boston, President W. H. Walker in the chair. Sixty members were present.

Dr. Carl Otto Weber, of Manchester, England, addressed the section on the 'Application of Scientific Data to Technical Problems in India Rubber Manufacture,' in which he discussed the various steps in the evolution of a scheme for rubber analysis, and the methods of applying the results to the theoretical and practical consideration of the chemistry of india rubber.

ARTHUR M. COMEY,
*Secretary.*

## DISCUSSION AND CORRESPONDENCE.

### CONVOCATION WEEK.

TO THE EDITOR OF SCIENCE: I am in hearty sympathy with nearly all the opinions expressed in the recent article in SCIENCE entitled 'Convocation Week.' The American Association has a large membership. One of its chief functions is to provide for its members the means of getting together for scientific and social intercourse. The plan of a convocation week into which might be gathered so far as practicable the numerous scattered meetings of special societies, which were being held without any correlation of time or place, was in my opinion a distinct step in advance.

When the question of winter meetings for the American Association first began to be considered it became evident that many members of the association preferred the summer meeting. Comparatively few probably would attend two meetings a year, but I think it safe to estimate that if by its present plan of holding one meeting a year the association succeeds on the average in securing an attendance of 500 of its 4,000 members, it would, by holding both summer and winter meetings, in localities and at times selected with judgment, have almost if not quite as large an attendance at each. It would thus double its usefulness by supplying the facilities for a scientific meeting to twice as many of its members every year.

The general feeling in the west is for summer meetings. In the east the majority favors meetings in the winter, but the geographical lines are not sharply drawn. Many of us would be glad of a choice between the summer and the winter meeting with privilege of attending one, both or neither at our convenience. The summer meetings should be held, as a rule, in some attractive and accessible resort; in the mountains, on the lakes or at the seashore. By selecting the earliest possible date after the closing of our colleges it would be practicable to house the entire attending membership under one roof. The great summer hotels at the beginning of the season are almost empty and they would welcome the association. The end of the summer, while desirable in certain respects, is the crowded season at such places and it would be difficult to find suitable accommodations.

Summer meetings would probably be as well attended as those held in convocation week; the attendance at the former would indeed be the much larger but for the greater gathering of the affiliated societies in winter.

The association in bringing together men of many sciences has a more important function than appears to be commonly recognized. Without some such organization we shall meet in the various special societies only those who are engaged in our own particular lines of work. The bringing together of the various affiliated societies at a common meeting place helps to mitigate one of the most unfortunate features of modern specialization in science, namely, the separation of men of science into small groups. Moreover, the formation of special societies has gone so far that every one is compelled to hold membership in several. In addition to being a member of the American Physical Society the physicist is or should be interested in the work of the Institute of Electrical Engineers, of the Physical Chemists, of the Society for Astrophysics, of the Mathematical Society, of the Electro-Chemical Society, etc. The affiliation of these and other special societies in the American Association would make it easy for one to get in touch at least once a year with the various activities which they represent, hence the importance of convocation week. It is not less imperative that the American Association afford those of its members who can not attend its winter meetings an opportunity for intercourse with kindred spirits at times and places possible to them. The question of the expense of two meetings a year is not worthy of consideration. It is absurd to say that an association with a membership of 4,000 is unable to carry on two, or if desirable, even more meetings every year.

E. L. NICHOLS.

WHEN the American Scientific Association was organized in 1847 it was, like its immediate predecessor the Association of American Geologists and Naturalists, the only national society devoted to pure science in

this country. To be elected a member was a certificate of scientific standing. Its first president, William B. Rogers, was equally well known as a physicist and as a geologist, and the day of close specialization had not yet begun. The formation of the National Academy during the civil war was not undertaken with a view to organizing any more select body of investigators, but rather for utilitarian purposes. To be selected as a scientific adviser for the government was a high honor, but it seems not to have interfered with the loyalty of any member to the national association. At the memorable Albany meeting in 1851 about 27 per cent. of the total membership of 769 were present. At the Washington meeting in December, 1902, about 27 per cent. of the total membership of 3,596 were present.

That differentiation should result from increasing growth was naturally to be expected. In 1875 the first division into two sections was made, the total membership being still only 807. It was at the Saratoga meeting in 1879 that the policy of popularizing the association seems to have been inaugurated, the barriers to membership, in the form of recognized scientific credentials, being in great measure removed. The next meeting, held in Boston, was attended by 997 persons, and the total membership was increased to 1,555. At the Cincinnati meeting in 1881, although the attendance was but half that of the Boston meeting, it was decided to break up into nine sections. Already a serious source of embarrassment had sprung into existence in the form of an invasion of cranks. About the same time was noticed the absence of a number of members of the National Academy who had formerly been regular attendants. To guard against the admission of papers by ill-balanced or ignorant persons it was necessary to form committees of inspection whose duty it should be to suppress such papers, a summary of each being required before it could be presented to any section. The laxity in regard to admission soon became such as to develop the wide-spread impression that anybody of either sex could be elected to membership by exhibiting willingness to pay the usual fees.

If the term scientific aristocracy is admissible at all it was applicable to the association in its earlier days. The rapid change to democracy after the Saratoga meeting produced dissatisfaction among many, and this was manifested in the formation of the American Chemical Society as an offshoot. The interest of its members was very perceptibly withdrawn for a time from Section C, although affiliation was claimed. One after another of these affiliated societies has since been formed, until their number now considerably exceeds the number of sections of the parent association. Where the affiliated society has a field identical with that of a section of the association the two usually meet together, as a matter of courtesy, but division is still perceptible. The American Physical Society, for example, has four meetings each year, the agreement being that one of them shall be held in conjunction with Section B of the association and the others usually in New York. The chief reason alleged for the formation of the Physical Society was that many of the leading physicists of the country could not be induced to attend the meetings of the larger association on account of the lack of discrimination in its make-up. It has been repeatedly noticeable that some of the most active members of the Physical Society were absent from the joint meetings. No ground for criticism is implied in such a statement. Every one is perfectly free to attend only such meetings as are found attractive, and an appeal based on loyalty to the parent association can never be effective, especially now that the number of gatherings is so great that nobody can attend them all.

The tendency toward disintegration of the growingly unwieldy national association is not due merely to increasing diversity of interests or undue liberality in admitting those who are not specialists. The great size of our country and the consequent expense involved in long journeys make the conditions essentially different from those which seem to have maintained the unity of the British Association. Reduced rates on the railroads can

generally be secured for almost any gathering of more than fifty or a hundred persons, but in spite of this a trip from Boston or Savannah to Denver or San Francisco implies an expenditure in both money and time which is prohibitive to many. The plan advocated by the editor of SCIENCE, that each affiliated society shall send delegates to the annual meetings of the national association, is much to be commended and well worth trying, but its availability depends much upon the location of each delegate's home with regard to the place of meeting. The tendency toward the formation of separate societies irrespective of the American Scientific Association seems now to be well developed. Two of them met recently in New Orleans where they launched a third into existence. Recommendations may be made at will by those who wish to maintain unity, but the ordinary processes of evolution will continue without regard to individual preferences.

The present writer gives his hearty approval to the views advocated by the editor of SCIENCE, which have been well thought out. The policy of adaptation to the multitude inaugurated at the Saratoga meeting has had nearly a quarter of a century in which to become fixed. Whatever change may yet be developed, it will not be to the conditions of 1850. No plan elaborated by any single individual will be carried out in full, but the views of many, if given full expression, will be helpful in preparation for the Philadelphia meeting.

W. LE CONTE STEVENS.

WASHINGTON AND LEE UNIVERSITY,
January 16, 1904.

THE Editor of SCIENCE invites comments upon the article 'Convocation Week' published in that periodical on January 8. With much of the article I am in full accord, but with one matter I do not agree.

As the article in question says, there was considerable friction at the Washington meeting a year ago. Under the circumstances this seemed unavoidable. The rooms available were few in number and, naturally, the association and its sections were first provided for. The result was that at least two of the independent societies—the Zoologists and the Anatomists—were forced to put up with inadequate and inconvenient quarters. It would seem probable that similar disagreeable and irritating conditions will recur whenever so many organizations meet together. The only escape seems to be either the merging of the separate societies in the sections of the association or in their meeting apart, as several did this year.

The greatest objection to such a merger is the enormous extent of our country. The association is national in character and its meetings have been held at points as remote from each other as Portland and Denver, Charleston and Minneapolis. It is the policy of the association to meet one year in the east, the next in the west—Denver, Washington, St. Louis, Philadelphia and New Orleans. With this no one can find fault. A national society should supply all parts of our country. When, however, the matter of amalgamation is considered, it is seen that many of the members, most of whom are living on moderate salaries, must either take long journeys or forego the meetings on alternate years.

Another objection is the difference in character between the association and the independent societies. The latter are strictly professional organizations, aiming at the advancement of science. As such they limit their membership, thus ensuring audiences, the majority of whom are able fully to comprehend any paper presented. The association admits all who apply for membership, and its function, in spite of its name, has largely become that of the popularization and diffusion of knowledge. There is nothing more difficult than the presentation of the results of research to an audience which can not appreciate the points made. Again, with the smaller societies under the present conditions there is too little time for discussion of the papers presented; united with the sections of the association the program would be so long that this valuable feature would be entirely lost.

In view of these facts it seems best to the writer that the societies should retain their independence and should hold their meetings

without regard to the movements of the larger organization. They might all meet together at times and places where the accommodations were adequate, but such places would be few and far between.

Of course, this would result, under the present conditions, in a society and a section with similar aims meeting in different places at the same time and a member of both might have difficulty in deciding which of the two he should attend. But the remedy is a simple one. These separate societies have, by right of preemption, a claim upon the Christmas holidays for their meetings. The whole trouble has been caused by the American Association for the Advancement of Science, which has encroached upon this period and is now trying to force the independent organizations to accommodate themselves to its actions. All that is necessary for full harmony is that the association return to its summer meetings, leaving the Christmas vacation free to its rightful possessors.

J. S. KINGSLEY.

TUFTS COLLEGE,
January 13, 1904.

THE SCINTILLATIONS OF RADIUM.

THE phenomenon of the scintillation of a phosphorescent screen, under the influence of the radium bombardment, which was first described by Sir William Crookes, is one of the most impressive spectacles which we have had for a long time.

As comparatively few of us have had an opportunity of witnessing this remarkable sight, I have prepared about two dozen 'spinthariscopes,' which I shall be very glad to pass around among my colleagues, on the condition that they be promptly returned.

Last autumn, while experimenting with some phosphorescent materials, I found that the scintillations could be as easily seen when the radium was mixed with the phosphorescent powder (the mixture being pressed between two plates of glass) as in the usual form of Crookes's spinthariscope.

If one sits for several minutes in an *absolutely dark* room, and then examines the plate with a powerful pocket magnifying glass, the appearance reminds one of an enormous star cluster as seen in a telescope, the individual stars lighting up and disappearing in rapid succession, producing an impression which has been likened to that produced by moonlight on rippling water.

Whether the flashes are produced by the impact of the individual electrons which constitute the $\alpha$ rays, as was imagined by Crookes, or whether they represent microscopic cleavages which are occurring in the crystals as a result of the bombardment, as Becquerel believes, is still an open question. The fact that hundreds of flashes appear every few seconds, the action showing no signs of abatement after several months, makes it difficult to believe that each flash represents a split in a crystal, unless one is prepared to accept the doctrine of 'infinite divisibility.' It is, perhaps, equally hard to believe that the impact of a single electron is responsible for each flash. The obvious way of settling this question would be to make a rough estimate of the number of flashes produced in a given time by a very small amount of radium of very low activity, and see if the number was of the same order of magnitude as the number of positive electrons given off in the same time. If the number of emitted electrons far exceeds the number of flashes, we may find a way out of the difficulty by assuming that the electrons are thrown out in intermittent streams, the impact of each 'squirt' producing a flash.

On carefully scrutinizing the screen it is almost impossible to avoid forming the opinion that the points of light are in motion, the whole field squirming with light, like a colony of infusoria under the microscope. This appearance is, perhaps, a little more pronounced with the Crookes spinthariscope, in which a speck of highly active radium is mounted at a little distance above the screen. If this motion should turn out to be real and not illusory it could, perhaps, be explained by a slight sweeping motion of the streams of electrons emitted by the radium. Such speculations are scarcely worth while, however, in view of the very deceptive nature of illusions of motion. The plates which I have prepared for distribution are packed in small tin boxes, which can be sealed up in an ordinary envelope. Institutions desiring to borrow one will be

accommodated as promptly as possible. The limited number of plates available will of course cause more or less delay in complying with many requests. A prompt return of each plate is to the interest of all. A self-addressed envelope with four cents in postage affixed should accompany each application.

Failure to observe the phenomenon can only result from an insufficient resting of the eyes. Half an hour in subdued light such as lamp-light, followed by four or five minutes in *absolute* darkness is the *sine qua non* of success.

The magnifying glass employed should have a power of five or six diameters. A Coddington lens, or Hastings triplet is suitable.

R. W. Wood.

Johns Hopkins University.

## SPECIAL ARTICLES.

### THE OCCURRENCE OF ZINC IN CERTAIN INVERTEBRATES.

In the course of an investigation on the chemical physiology of certain invertebrates, undertaken under the direction of Dr. Lafayette B. Mendel, it was found that the ash of the hepato-pancreas of the large carnivorous gastropod, *Sycotypus canaliculatus,* contained an element hitherto unobserved in such connection, namely zinc. So far as the writer is aware, this element has never been observed as a normal constituent of the tissues of any animal, vertebrate or invertebrate. The reaction by which zinc was first suspected was the ordinary ferrocyanide test for ferric iron in acid solutions. Not only was iron present, as indicated by the blue color, but some other metallic element as well, giving a marked slimy precipitate. Further investigation showed the presence of a heavy metal having all the characteristic chemical properties of zinc.

Quantitative separations were made difficult by the presence of very large amounts of phosphoric acid, and the basic-acetate method was resorted to. The well-known limitations of the latter make it, however, scarcely more than of qualitative value. By this method samples of ash from *Sycotypus canaliculatus* gave approximately eleven per cent. and twelve per cent. respectively of ZnO.

Further separations have since been made by means of Hampe's well-known method (slightly modified),* depending upon the precipitation of ZnS from a formic acid solution of sufficient strength to prevent the precipitation of the iron. By this method concordant results have been obtained as shown in the table below. At the same time qualitative examinations were made of specimens dredged from various parts of Long Island Sound about New Haven, and in all cases zinc was found in large quantities in the ash of *Sycotypus* and *Fulgur carica.*

Copper was estimated electrolytically in each case; in one sample by the rotating cathode method of Gooch and Medway. Iron was determined by permanganate titration in the usual way. Blanks were run through to detect the possible presence of zinc in the reagents, and great care was exercised throughout to prevent any contamination.

Other tissues besides the hepato-pancreas were incinerated and examined, and other gastropods and crustacea dredged from the same localities were also tested. With the exception of the blood of *Sycotypus,* no further occurrence of zinc has yet been detected.

The following table of ash analyses summarizes the result of the investigation as far as it has been carried.

| | Samples Obtained. | Fe. | Cu. | ZnO. |
|---|---|---|---|---|
| *Sycotypus* (hepato-pancreas. | May, 1903 | Present | Present | Present |
| *Sycotypus.* | May, 1903 | " | 8.57% | 11.97% |
| *Sycotypus.* | May, 1903 | " | 8.17% | 10.81% |
| *Sycotypus.* | Sept., 1903 | " | 8.47% | 19.00% |
| *Sycotypus.* | Sept., 1903 | " | 7.83% | 23.38% |
| *Sycotypus.* | Nov., 1903 | 0.84% | ........... | 18.80% |
| *Sycotypus.* | Nov., 1903 | 0.84% | ........... | 18.60% |
| Blood of *Sycotypus.* | Nov., 1903 | Present | Present | Present |
| *Fulgur.* | May, 1903 | " | " | " |
| *Fulgur.* | Sept., 1903 | " | " | " |
| *Fulgur.* | Nov., 1903 | " | " | " |

The following other marine forms have been examined for zinc, with negative or doubtful results in all cases: *Urosalpinx cinerea, Mytilus edulis, Modiola plicatula, Argina*

* W. Hampe, *Chemiker Zeitung,* IX., 543 (estimation of zinc).

*pexata, Eupagurus pollicaris, Ostrea virginiana* and *Cancer irroratus*.

The significance of this unique occurrence of zinc in the economy of *Sycotypus* and *Fulgur* is still to be determined, as is the nature of the combination in which it exists. These points, together with the distribution of the element in other marine forms about the sound, are at present being investigated and will be reported upon later.

HAROLD C. BRADLEY.
SHEFFIELD LABORATORY OF PHYSIOLOGICAL CHEMISTRY, YALE UNIVERSITY.

## ATMOSPHERIC NITROGEN FOR FERTILIZING PURPOSES.

OF much interest to scientific students of agricultural economy is the report of the United States Consul-General Mason, at Berlin, Germany, on a new method of producing nitrogen from the atmosphere for soil fertilization, as announced in the daily 'Consular Report,' No. 1804, issued by the Bureau of Statistics, Department of Commerce and Labor.

The gradual but ultimately inevitable exhaustion of the known nitrate deposits of South America, the report states, lends a growing interest to the methods which have been devised for obtaining a supply of nitrogen for fertilizing purposes from the inexhaustible storehouse of the air. That this can be done as a scientific process has long been known. The first method was by passing a current of air over red-heated copper, whereby the oxygen combined with the metal to form oxide of copper, leaving the nitrogen free. At first the nitrogen thus produced was fixed by combination with calcium carbide to form nitrate of lime (Kalkstickstoff) or calcium cyanimide, a combination of lime carbon and nitrogen, which had all the essential properties of a nitrate fertilizer. But as the use of calcium carbide rendered the product unduly expensive, a method was sought which would employ a substitute for that material, and this was found by Dr. Erlwein, who brought the nitrogen into combination with a mixture of powdered charcoal and lime in an electric furnace. The product of this combination is a black substance containing, besides the lime and carbon, ten to fifteen per cent. of nitrogen, in perfect condition to be used as a fertilizer. From the experiments thus far made with this new artificial nitrate—which is known in commerce as calcium cyanimide—it appears that its nitrogen acts upon plants quite as effectively as that contained in a proportionate quantity of nitrate of potassium or sodium nitrate (Chile saltpeter). The scientific problem of obtaining nitrogen for fertilizing purposes from the atmosphere would seem, therefore, to be satisfactorily solved. Whether it can be done on a very large scale and at a cost which will make it economically available for general agricultural purposes remains to be demonstrated by practical experience.

JOHN FRANKLIN CROWELL.

## MISSOURI LEAD AND ZINC REGIONS VISITED BY THE GEOLOGICAL SOCIETY OF AMERICA.

AT the close of the St. Louis meeting of the Geological Society of America, January 2, an excursion to the Missouri lead and zinc regions was given by the Missouri Bureau of Geology and Mines to the members of the society whose work would allow them time for the journey. In the company several universities were represented—Alabama, Dartmouth, Kentucky, McGill, Missouri, Northwestern, Rochester, Springfield and Toronto, and several members of geological surveys were present—Geological Survey of Canada, Missouri, Ontario, West Virginia and the United States. The excursion allowed of a view of the Missouri geological scale from the St. Louis formation (of the sub-Carboniferous), through Devonian, Ordovician, Cambrian to the Algonkian, and many phases of geology, from *peneplain* to paleontology, had their share of attention. However, the chief place in the thought of the visitors was occupied by the mineral resources of the famous lead and zinc localities. A day and a half was spent in the eastern lead region—the classical locality for lead production in the Mississippi valley. A number of mines and mills at Bonne Terre and Central were visited, and the facts obtained there, when combined with those ob-

tained on the visit made during the American Association for the Advancement of Science meetings to the lead pipe works in St. Louis, gave a complete view of the lead industry, from deposits disseminated in the Third Magnesian Limestone to the finished product, to be disseminated eventually throughout the homes and shops of American cities. A dozen mines a score or two miles from the old mine LeMotte, famous in the history of lead mining in the Mississippi valley are being worked by modern methods. Companies of large capitalization are able to mine and mill successfully in a region where the individual could not afford to work, and the annual production is now measured by millions of dollars. At the St. Joe Mine a depth of 350 feet has been reached, and the workings extend about two miles from north to south. One chamber is about 130 feet in length, and furnished ore throughout its entire distance. The mines are in the Bonne Terre or lower division of the Third Magnesian Limestone—a shaly magnesian limestone about 500 feet thick, which rests on Potsdam sandstone, and is overlaid by the Potosi, or upper member of the group. The size and perfection of the concentrating and milling plants were a surprise to the visitors. Two mills were visited, each of which has a daily capacity of 1,500 tons.

Some of the party took a side excursion to Pilot Knob and Iron Mountain. The character of the iron formations reminded the visitors of similar formations in the Lake Superior region.

From the eastern region the company were taken four hundred miles to Joplin and Webb City, where sub-Carboniferous zinc and lead deposits and the treatment of their ores occupied the attention for a day. A few of the eight hundred mines in the region were not visited. The two which were examined gave an idea of the remarkable richness of the region, and explained the prosperous condition of the cities in southwestern Missouri. Picturesque names are not confined to the far west. The 'One Gallus Mine' shows such deposits of sphalerite as to make the most thorough pessimist forget his position. This region is still favorable as a 'poor man's diggings.' With almost no capital, a man can lease a plot of ground and start in to make his fortune. Yet improved methods and well-equipped mills are seen on every hand, and have as a result the addition of several millions of dollars' worth of lead and zinc to the wealth of the country.

The excursionists were shown unlimited hospitality by various organizations in the regions visited, and by five railroad companies, which not only carried the party nearly a thousand miles, but furnished extra engines and held an important train in order that our delayed car could be attached.

The value of the trip was enhanced by the unending courtesy of our 'English-speaking guides,' Drs. Shepard, Wheeler and Buckley, who were ever ready to answer questions and point out facts of interest.

The excursion was due to the enterprise of the state geologist, Dr. Buckley, to whom the visitors are under very pleasant and great obligations for the increased knowledge which they have of the geology of the remarkable lead and zinc deposits of Missouri.

A. R. Crook.

Northwestern University.

## SCIENTIFIC NOTES AND NEWS.

The Lalande prize in astronomy has been conferred upon Director W. W. Campbell, of the Lick Observatory, by the Paris Academy of Sciences.

The Gold Medal of the Royal Astronomical Society of London has been conferred upon Professor George E. Hale, director of the Yerkes Observatory, for his researches in solar and stellar physics.

We understand that at its recent meeting the executive committee of the Carnegie Institution adopted the recommendation of the biological committee to establish a Department of Experimental Biology and to call Professor C. B. Davenport, of the University of Chicago, to the charge of it. The work of the department will include at present, among others, a station for Experimental Evolution at Cold Spring Harbor, Long Island, on land granted by the Wawepex Society, and a Tropical Marine Biological Station at the Dry

Tortugas. Dr. Davenport is proposed as director of the former station and Dr. Alfred G. Mayer, of the Museum of the Brooklyn Institute of Arts and Sciences, as director of the latter station. Fuller details are promised as the plans of the department progress.

Professor Karl Schleich, of Berlin, has received from the University of Würzburg a medal and a 1,000 Mark prize for the discovery of a method of making surgical operations painless by what he calls the 'Infiltrationsanaesthesie.'

The University of Giessen has conferred its honorary doctorate on Herr Hermann Strebel, of Hamburg, for his work in zoology and Mexican archeology.

A portrait of Dr. Robert Fletcher, editor of the *Index Medicus,* will be presented to the Library of the Surgeon General's office, Washington.

Professor Chantemesse, professor of experimental and comparative pathology at the University of Paris, has been appointed to succeed the late Professor Proust as general inspector of the French Sanitary Service.

Professor W. F. M. Goss, of Purdue University, who has been engaged for some time in testing locomotives, has been granted $5,000 by the Carnegie Institution to carry on the work.

Professor Josiah Royce, of Harvard University, will give the following lectures at Columbia University at 4:30 P.M.

February 1, 'The Comparative Study of Scientific Concepts.'

February 2, 'General Survey of Certain Fundamental Concepts of Science; (1) Classes and Classification, (2) Relations and their Types, (3) Ordinal Concepts and Ordinal Series.'

February 8, '(4) Concepts of Transformation, (5) Concepts of Levels.'

February 9, 'Application of the Survey to Various Special Problems.'

February 15, 'Philosophical Consideration suggested by the Survey.'

Dr. W. M. Bayliss is giving a course of ten lectures on 'Enzymes and their Actions,' at University College, London.

*The Sibley Journal of Mechanical Engineering* has published a memorial number in honor of the late R. H. Thurston. It contains a biographical notice by William Kent; an appreciation entitled 'Our Friend,' by John H. Barr; an article entitled 'Dr. Thurston's Work in Sibley College,' by H. J. Ryan and R. C. Carpenter; an article entitled 'The Literary Work of Dr. Thurston,' by H. Diederichs; and a partial list of papers by Dr. Thurston.

The steamship *Princess Irene,* bringing the remains of James Smithson, arrived in New York on January 20. These were transferred to the *Dolphin* of the U. S. Navy and taken to Washington. They have been deposited in the Smithsonian Institution until arrangements can be made for suitable burial in the grounds of the institution and the erection of a monument. As readers of Science know, the remains were brought to this country by Dr. A. Graham Bell, at whose instance the regents arranged for the removal, owing to the fact that the English cemetery at Genoa in which Smithson was buried was to be abandoned.

The Rev. George Salmon, F.R.S., provost of Trinity College, Dublin, and eminent for his mathematical publications, died on January 22 at the age of eighty-five years.

We regret also to record the death of Dr. Wilhelm Behrens, professor of botany at Göttingen.

The sum of four thousand dollars has been granted to the Lick Observatory by the Carnegie Institution for the employment of assistants in the year 1904, in continuation of the grant of an equal sum for the year 1903.

The daily papers report that Professor A. H. Phillips, of Princeton University, has extracted radium from carnotite, an ore found in Utah, and that an abundant supply of this ore exists.

The observing station of the D. O. Mills expedition to the southern hemisphere, from the Lick Observatory of the University of California, was completed in October. It is located on the summit of San Cristobal, a hill 1,000 feet high in the northeast suburbs of Santiago, Chile. The elevation of the plain on which Santiago is built is about 1,800 feet above sea level. The principal item of equip-

ment consists of a large Cassegrain reflecting telescope with clear aperture of 36½ inches; a modern three-prism spectrograph; a thirty-foot Warner & Swasey steel dome, and office buildings. Spectrograms had been secured by November 1 for determining the radial velocities of twenty-five or more stars. It is expected that results will rapidly accumulate, as the equipment is devoted to this purpose exclusively. The station is in charge of Acting Astronomer William H. Wright of the Lick Observatory staff, who is assisted by Dr. Harold K. Palmer.

Sr. Francisco M. Rodriguez, director of the Museo Naçional, City of Mexico, reports several interesting discoveries of ancient remains in the valley of Mexico. In the southeastern part of the valley, a number of hieroglyphic inscriptions cut in the rock have been found. In the southwestern part of the valley Mr. Rodriguez has discovered the remains of ancient habitation sites in nearly a score of places, and also rock inscriptions which seem to date back to a remote epoch. The museum authorities have plans for the removal to the museum of the famous tablets at the ruins of Palenque.

A despatch from Yakutsk, eastern Siberia, dated January 15, says that boatmen of the expedition commanded by Lieutenant Kolchak had arrived there and reported that the efforts of the expedition to find Baron Toll on New Siberia and Bennett Islands, in the Arctic Ocean, have been unsuccessful. Baron Toll left documents on Bennett Island showing that he turned southward on November 8, 1902.

The president of the British Board of Agriculture and Fisheries has appointed a departmental committee to inquire into and report upon the present position of fruit culture in Great Britain, and to consider whether any further measures might with advantage be taken for its promotion and encouragement. Mr. A. G. Boscawen is chairman and Mr. Ernest Garnsey secretary of the committee.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

The will of the late Charles F. Doe, a lumber manufacturer of San Francisco, bequeaths about one fourth of his estate to the University of California for a library. The university will receive over $500,000.

Towards the fund being raised by the senate of the University of London for the proposed Institute of Medical Sciences, Mr. Butlin, the dean of the Faculty of Medicine, has contributed £1,000, and Sir William Church, president of the Royal College of Physicians, and Mr. Tweedy, president of the Royal College of Surgeons, £100 each.

Assemblyman Davis of the Committee of Public Education has introduced in the assembly of New York State a bill providing for educational unification and the reorganization of the Board of Regents. The bill provides that the secretary of state shall draw nine names from a box containing the names of the present Board of Regents, and the persons thus indicated shall constitute the Board of Regents, serving for from one to nine years. Thereafter one regent is to be elected each year, to serve for a period of nine years. They are to elect a commissioner of education, to serve during the pleasure of the board, at an annual salary of $7,500 a year. He shall perform the duties now devolving upon the superintendent of Public Instruction and the secretary of the board of regents, both of whose offices are abolished. The first commissioner is to be elected by the legislature. Neither the state superintendent nor any member of the Board of Regents, nor any employee or appointee of either shall be eligible.

Governor Odell has sent to the senate the report of the director of the New York State School of Forestry and a letter from President Schurman of Cornell University. In his letter President Schurman states that Governor Odell's recommendation that the experimental work be resumed subject to the condition that the state assume liability for the contracts that Cornell University has already entered into, is acceptable. The university is willing to acquiesce to a discontinuance provided it is protected against any liability on contracts which as agent of the state it has made in connection with the operation of the school.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 5, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

### *SECTION B, PHYSICS.*

THE annual meeting of Section B, Physics, of the American Association for the Advancement of Science, in affiliation with the American Physical Society, was held in St. Louis, from December 28 to 31. The sessions were universally pronounced successful and enjoyable. The attendance varied from forty to seventy-five, and was representative of the middle west, while there was also present a number of the prominent members from the east, and a few from the Pacific coast.

The retiring vice-president, Professor E. F. Nichols, of Columbia University, was unable to be present. The section passed a resolution expressing its disappointment in not having the opportunity of listening to the expected vice-presidential address.

The presiding officers were Professor E. H. Hall, of Harvard University, vice-president of Section B, and Professor A. G. Webster, of Clark University, president of the American Physical Society. The other officers of the section who were in attendance were Dayton C. Miller, secretary; D. B. Brace, councilor, and the following members of the sectional committee—E. H. Hall, D. C. Miller, Ernest Merritt, D. B. Brace, A. G. Webster and F. E. Nipher.

For the next meeting to be held in Philadelphia, from December 28 to 31, 1904, the vice-president is Professor W. F. Magie, of Princeton University. The other officers for the Philadelphia meeting, so far as now determined, are: retiring vice-presi-

dent, E. H. Hall; secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio; members of the sectional committee, E. H. Hall, W. F. Magie, D. C. Miller, D. B. Brace, A. G. Webster, G. F. Hull and F. E. Nipher.

Professor E. Rutherford, of McGill University, gave a popular scientific lecture on 'Radium and Radio-activity.' The lecture was illustrated with many experiments and demonstrations, some exhibiting Professor Rutherford's recent researches. The lecture was greatly appreciated by the large audience in attendance.

The number of papers read at St. Louis was thirty-six, twenty-four before Section B, and twelve before the Physical Society. Of these papers thirteen were upon electrical subjects, eleven were optical, four were upon heat, three upon radio-activity and five were upon miscellaneous subjects. The abstracts of the papers read before Section B are given below; the papers given before the Physical Society are described in the report of that society.

*Report of the Committee on the Velocity of Light:* D. B. Brace, University of Nebraska.

*A Half-Shade Elliptical Polarizer and Compensator:* D. B. Brace, University of Nebraska.

To be published in full in the *Physical Review.*

*On the Effect of a Magnetic Field on the Interference of Natural Light:* John Mills, University of Nebraska.

The conception of natural light as an elliptical vibration and our knowledge of the Faraday 'effect' would give as a criterion for an analogous rotation of natural light, the disappearance of interference fringes, previously observable, upon the formation of a magnetic field capable of rotating plane polarized light through an angle of an odd multiple of 90°. The apparatus consisted of a Michelson interferometer. In the path of each beam was placed a tube of carbon disulphide surrounded by a solenoid. Natural monochromatic light was used and the current varied. Observations were taken at the points of disappearance and reappearance of the fringes. The mean of these current readings was taken as that for which interference was impossible. These values of the current would have produced in plane polarized light a rotation of 95.8°, 256.8°, 447.5°, 613.6°.

The apparent invalidation of the results obtained because of a partial polarization of the entering light by the reflecting surfaces is also discussed.

*On the Velocity of Light in a Magnetic Field:* John Mills.

The experimenter undertook to measure the acceleration or the retardation experienced by a circular component traversing a magnetic field. The apparatus consisted of a Michelson interferometer. In the path of each beam was placed a tube of carbon disulphide surrounded by a solenoid. The light passed through a Nicol prism and a Bravais double plate. Half of the fringes were thus composed of light circularly polarized in a direction opposite to those of the other half. The formation of a magnetic field produced a shifting of the two sets in opposite directions. The current causing a shifting of one full band (corresponding to a difference in phase of 360°) was observed. On the assumption that the rotation of plane polarized light is the result of a difference of phase between its circular components, produced by an acceleration of one component and a corresponding retardation of the other, the difference of phase corresponding to this value of the current was calculated. It was 368°. The readings for the current

giving a displacement of three bands (that is, a difference in phase of 1080°) corresponded to a difference of 1101° calculated.

*Hertzian Waves since Hertz:* A. D. Cole, Ohio State University.

Hertz's experimental proof of the existence of electromagnetic radiation in 1888 was the culmination of Maxwell's work and led to a large output of new research. In this Germany took the lead. Arons, Lecher, Boltzmann and Zehnder introduced better methods of showing the electrical waves. The coherer came in 1895, although its principle was discovered by Branly in 1891. Three of the new receivers were strictly quantitative; the electrometer of Bjerknes, the oscillation-bolometer of Paalzow and Rubens and the thermo-receiver of Klemenčič. Important improvements in the exciter were made by Righi in 1893 and by Blondlot. J. J. Thomson and Lecher used the Hertzian oscillations to measure dielectric constants. Rubens and Arons showed that the Maxwellian relation between these and the refractive index held better with Hertzian than with light waves. Cohn extended this to the case of water. This was shown to be rigidly true by Drude, by Cole and by Cohn and Zeeman. Cole showed that alcohol possesses anomalous dispersion for electrical waves. Drude and Lampa proved this true of many substances. Drude perfected apparatus for determining refractive indices. Lecher and also Larasin and de la Rive showed that the velocity along wires is the same as in air. Blondlot, Trowbridge and Duane, and Saunders gave more exact proofs that this velocity was that of light. The gap between the wave-lengths of electrical and light waves has been narrowed from each side. Lebedew reduced the former to 1 mm., Dubois and Rubens produced longer infra-red waves.

The essentials of the electromagnetic theory have been established. It remains to correlate with it our views of corpuscles and the Becquerel rays.

*A Simple Alternate Current Frequency Recorder:* E. S. Johonnott, Rose Polytechnic Institute.

The instrument may be attached directly to alternating current mains and a record of the frequency obtained. To one pole of the electromagnet of an ordinary electric bell is attached a light armature which is held at some little distance from the other pole by a stiff flat spring. If now an alternating current is sent through the coils the armature vibrates, ordinarily, with a frequency equal to twice that of the current. If a stylus be arranged on the outer end of the armature to leave a trace on a smoked drum alongside that of a seconds pendulum or an electromagnetic tuning fork the frequency may be counted off at once. The current through two incandescent lamps in parallel in 100 volts is sufficient to give ample motion.

*Iron Losses in Loaded Transformers:* E. S. Johonnott, Rose Polytechnic Institute.

With the addition of a differential coil to the Rayleigh phasemeter it was adapted to measure directly the loss of energy in the iron of a loaded transformer. The readings give at once also the magnitude of the exciting current and its phase with respect to the induction. A transformer of special design to test the effect of magnetic leakage was used in the experiments. The conclusions drawn from the work were as follows: (1) In a transformer having great magnetic leakage between the primary and secondary, and in which a constant induced E.M.F. is maintained and measured. (*a*) In the secondary. There is an apparent increase in values of the loss of energy in the iron, the magnitude of the exciting current and the cosine of the angle

of lag between this current and the induced E.M.F. as the load in the secondary is increased. (*b*) In the primary. There is an apparent decrease in the loss of energy in the iron, the magnitude of the exciting current and the cosine of the angle between, as the load increases. (2) If the load is increased in the secondary of a transformer in which there is little magnetic leakage, not only the loss of energy in the iron, but the exciting current and its phase with respect to the induction remain constant.

*A Method for the Determination of Mutual Induction Coefficients:* Augustus Trowbridge, University of Wisconsin.

The method is based on the fact that when a pair of coils are joined in series so that the magnetic tubes of force form one thread through the other in the same direction as those due to it the self-inductance of the pair is $L_1 + 2M + L_2$. When the current is reversed through the one coil but not through the other the coefficient of self induction of the pair is $L_1 - 2M + L_2$.

By a bridge method each of these quantities may be determined in terms of a standard self inductance and thus $M$ (the coefficient of mutual induction) is obtained. A careful comparison of the results obtainable with this method with those by other known methods seems to be considerably in favor of this method, the probable error being about 1 part in 800.

*The Influence of Occluded Hydrogen on the Electrical Resistance of Palladium:* W. E. McElfresh, Williams College.

To be published in full in the *Transactions of the American Academy of Arts and Sciences.*

*On Hydrogen-charged Palladium:* E. H. Hall, Harvard University.

This paper is a review of the main facts known in regard to the properties of hydrogen-charged palladium and an examination of the various suggestions which have been made as to the nature of the union between the two elements concerned. The point is made that previous estimates, by Graham and by Troost and Hautefeuille, of the density of the hydrogen in the combination gave values very much greater than the observed value of liquified hydrogen. These estimates practically neglected the possibility of spaces between molecules of palladium sufficiently large to admit molecules of hydrogen with little expansion of the solid. The evidence in favor of a definite chemical combination between the palladium and the absorbed hydrogen is, on the whole, inadequate.

*A New Form of Frequency Meter, Preliminary Note:* A. S. Langsdorf, Washington University.

The paper described a type of instrument to indicate frequency on alternating-current circuits, the readings to be independent of fluctuations of voltage on the line, the connections similar to those of an indicating wattmeter.

*A Remarkable Distribution of Carbon on the Bulb of a 'Hylo' Incandescent Lamp:* Arthur L. Foley, University of Indiana.

In the 'Hylo' turn-down incandescent lamp there are two filaments, one of 16 c. p. ($F$) and one of 1 c. p. ($f$), the former consisting of two and the latter of three turns. Whatever be the direction of the current, the filament coils are of opposite polarity.

When $f$ is burning $F$ is in series with it, but the current is insufficient to render the latter luminous. When $F$ is burning $f$ is short-circuited. Let $P$ and $P'$ be points on the globe at the ends of a diameter through the plane of the filaments, and $NS$ and $sn$ be points on the globe where

the axes of the filaments $F$ and $f$ meet it. At $P$ there is a deposit from one to two centimeters wide, while the globe is perfectly clear on either side. At $P'$ the conditions are exactly reversed, the central region being dark with clear glass on each side. At $n$, also at $s$, there is a small circular deposit about half the area of a turn of $f$. This deposit is surrounded by another in the form of a ring about one centimeter wide and two centimeters in diameter, the ring being open next to the base of the lamp. Between the central deposit and the ring the glass is clear. There is no deposit within two centimeters of the base of the lamp, and very little on the crown. The theory of molecular shadows and the Edison effect, so thoroughly worked out by Fleming* and others, explains the general character of the deposit, but seems to fail to explain the definiteness of it. In general the deposit is of uniform density and quite dark, while the clear places are perfectly clear, the line of separation being as definite as if the deposit had been laid on with a brush. The weak magnetic field of the small filament was sufficient to concentrate the deposit at the ends of its axes, leaving certain regions perfectly clear. It seems that it should be possible to keep clear any desired part of the wall of a vacuum table. The peculiarity of the deposit above described was noticed but a few weeks since, hence the incompleteness of this investigation. An attempt to age a number of similar lamps by running at an excessive voltage resulted in a practically uniform deposit.

*On the Charges given to Surfaces by the Diffusion of Ions, and the Earth's Negative Potential:* JOHN ZELENY, University of Minnesota.

Experiments are described showing that neutral ionized air in passing through a long tube at first gives a negative charge to the walls, but as it passes along it eventually gives them a positive charge. In passing through a short tube the ionized air acquires a positive charge, while the tube itself becomes charged negatively. Similar effects were obtained with dry carbonic acid, but when the gas was saturated with water vapor the effects were all reversed in sign. The experiments are all explained by supposing the charges to arise from the unequal rates of diffusion of the two ions. It is shown that Villari's hypothesis that charges are given to metals by the friction of the ionized gas against the metal does not suffice to explain all of the facts. Simpson's objection to Geitel's explanation of the earth's negative potential is next taken up and the results of the above experiments are used in refutation of the objection. Other theories of the cause of the earth's negative potential are briefly considered.

*The Rate of Propagation of Smell:* JOHN ZELENY, University of Minnesota.

The propagation of smell through tubes where the air is free from convection currents was found to be very slow, as has already been noted by Ayrton; showing that the fast propagation ordinarily observed in free space is due almost entirely to convection currents. For example, with ammonia diffusing through a tube a meter and a half long, over two hours elapsed before the smell could be detected at the other end of the tube. Using different lengths of tubing, it was found that the time required for the diffusion of the smell was roughly proportioned to the square of the length. Ammonia and hydrogen sulphide were used for the above experiments. The presence of ammonia could be detected chemically at a point in a tube after about

* 'Molecular Shadows in Incandescent Lamps,' *Philosophical Magazine*, Vol. 20, 1885. 'A Further Examination of the Edison Effect in Glow Lamps,' *Philosophical Magazine*, Vol. 42, 1896.

the same time as when the sense of smell was used for a detector. The rate of propagation of the smell of ammonia was not markedly different when this had to pass along the same tube either horizontally or vertically upward or vertically downward. With camphor, however, while the rates horizontally and downward were about the same, the speed upward was about twice as great. The smell given to iron and brass by rubbing these with the fingers was also tried, but gave no definite results.

*On the Theory of the Electrolytic Rectifier:* S. R. Cook, Case School of Applied Science.

When aluminum is the anode in an electrolytic cell in which oxygen is set free there is very quickly introduced into the cell an exceedingly high apparent resistance. If aluminum is made the kathode and carbon or platinum the anode, the resistance is normal and very low. The anomalous action of this cell was noted by Professor Tait in 1869, but the cell did not attract attention until 1897, when Pollok and Grätz showed that the cell could be used to rectify an alternating current. Since 1897 investigations on the electrolytic rectifier have been published by Wilson and Norden, Burgess and Hambuecher, Taylor and Ingals, and Dr. Guthe. Each investigator set forth an independent theory for the high resistance of the aluminum anode. The object of this investigation was to determine the cause of this anomalous action of the aluminum anode, and it was found by a series of measurements of the applied electromotive force and the current, and also of the counter electromotive force with the same current; that the very high apparent resistance could be accounted for on the theory that it was due to the counter electromotive force. The potentials were measured by methods that were independent of the resistance, and curves were plotted showing the direct and counter electromotive force with current. When the electromotive force is greater than a certain critical value depending on the temperature the high resistance breaks down. This was shown to be due to the crystallization of the film around the aluminum anode, which exposed free metallic surfaces to the ions. It was also shown by direct determinations that free metallic aluminum conducted as readily when anode as when kathode, and the counter electromotive force was due to charged ions that could not penetrate the film formed on the aluminum.

*On the Position of Aluminum in the Voltaic Series and the Use of Aluminum as a Positive Element in a Primary Cell:* S. R. Cook, Case School of Applied Science.

Wheatstone in 1855, while determining the position of aluminum in the voltaic series, found that when immersed in a dilute solution of potassium hydroxide aluminum was negative to zinc and positive to cadmium, tin, lead, copper, iron and platinum; and in a solution of dilute hydrochloric acid aluminum was negative to zinc and positive to other elements. The object of the research was to make quantitative measurements on the difference of potential between aluminum and the other elements in different solutions. Measurements were made in several alkaline solutions, three acids and several salts. It was found that the difference of potential did not remain constant, but, in general, any solution the negative ions of which would attack the aluminum producing a soluble compound, the potential was more constant than in those solutions in which oxygen was the negative ion forming with the aluminum an insoluble compound. Measurements were taken with zinc, cadmium, tin, lead, copper, iron and platinum in solu-

tions of potassium hydroxide, hydrochloric, nitric and sulphuric acid, and ammonium chloride, potassium chloride, aluminum and potassium sulphate. A primary cell composed of aluminum, potassium sulphate, aluminum and carbon, was also investigated. The peculiarity of this cell was that it gradually increased to a maximum and again fell to its normal value when disturbed. It was also shown that the amount of current that could be taken from the cell was very small, and that the temperature coefficient was positive.

*On the Differential Telephone:* WILLIAM DUANE, University of Colorado.

Two separate coils are wound on the bobbin of a telephone receiver, and by suitable means are adjusted so as to have equal resistance, and equal self-inductances, and so that the magnetizing effect of a current flowing through one coil would be annulled by that of an equal current flowing in the proper direction through the other coil. To measure a self-inductance the unknown coil $X$ and a variable self-inductance standard $S$ are placed in series with the two receiver coils respectively, and a non-inductive resistance box $R$ is inserted in series with $S$ or $X$, according as the resistance of $X$ is greater or less than that of $S$. The two entire circuits are joined in parallel, and an alternating E.M.F. is applied to the branch points. Values for $R$ and $S$ can be found easily, such that no sound is heard in the receiver, and, when this is the case, the self-inductance of $S$ equals that of the unknown coil $X$. The magnetizing effects of the two receiver coils can be equalized by placing a small auxiliary coil in series with one of the receiver coils and with its plane parallel to the axis of the receiver. Joining the two receiver coils in series and sending an alternating current through them, a position for the auxiliary coil can be found that completely extinguishes the sound. With a receiver that will detect $10^{-6}$ amperes, the theoretical accuracy is about one one-hundredth per cent. Practically an accuracy of one part in five thousand is not difficult, as absolute silence can be obtained, if there is no iron in coil $X$. The advantages of this method of measuring self-inductance are: (*a*) That the apparatus is portable and does not get out of order easily; (*b*) that great accuracy can be obtained and the manipulation is not difficult; (*c*) that only one standard is required, and it is not necessary to know the value of any resistance or bridge-wire lengths. The disadvantage is that the self-inductance of the standard must *equal* that of the unknown coil. A range from zero to 150 milli-henrys can be obtained, however, with ordinary laboratory apparatus.

*The Selective Reflection of Fuchsin:* W. B. CARTMEL, University of Cincinnati. Presented by D. B. Brace.

This investigation was undertaken in order to ascertain whether the reflection from substances showing metallic reflection agreed with the values computed from reflection formulas. The reflection from a film of fuchsin was determined for various wave-lengths. The films of fuchsin were deposited upon a glass plate, and the reflection was measured not only from the upper surface of the fuchsin, but also from the interface between the fuchsin and the glass. The measurements were made by means of a Brace spectro-photometer. Instead of using the usual method of comparing the light reflected from the fuchsin with the light reflected from some other substance, whose coefficient of reflection was assumed to be known, the reflected light was compared with the direct light from the same source which supplied the reflected light. The work was begun last summer at the University of Nebraska and is now being continued at the University of Cincinnati.

*Primitive Conditions in the Solar Nebula:* Francis E. Nipher, Washington University.

The writer has used the equations developed in his paper forming No. 5, Vol. XIII., of the *Transactions of the Academy of Science of St. Louis,* for computing the numerical values throughout the primitive solar nebula. He finds that the resulting density and pressure, if the nebula be assumed a gas, filling the volume internal to Neptune's orbit, is incompatible with known physical conditions. The author concludes that the solar nebula was composed of discontinuous masses of solid matter during most of its early life. It was only in its later stages that gravitating compression caused the central mass now called the sun to fuse and vaporize.

*On the Investigation of the Kinetic Theory of Gases by Elementary Methods:* Henry T. Eddy, University of Minnesota.

This paper establishes some of the principal results of the kinetic theory of gases, such as the mean frequency of collision, the mean free path, the number of molecules striking a given area per second, the ratio of the specific heats, etc., on the assumption of a given constant velocity for all molecules, by simple semi-geometrical methods.

*A Demonstration to disprove the Second Law of Thermodynamics:* Jacob Wainwright, Chicago.

Paper published in full by the author.

At the 1902 meeting, at Pittsburg, the author presented to the members of the section a demonstration having substantially this same title. That particular demonstration was based upon a phenomenon disclosed by the published research work of Emile Hillaire Amagat, of Paris, viz., 'At or about an absolute temperature of 274°, and at pressures above the critical pressure, carbon dioxide becomes practically or absolutely incompressible or inert, as regards the influence of pressure alone.' The demonstration was confronted by the suggestion that Amagat's work should be thoroughly verified before it could be accepted as evidence to effect a so important revolution in physical and chemical science. In order to overcome such difficulty, the subject was presented in a simple manner free from all questions of quantitative analysis and unverified matter. The pressure condition of a practically perfect gas is manipulated and transformed, and all postulations, except the 'first law' of conservation of energy, which is properly a postulation in a strict sense, but has been thoroughly verified as it relates to the various phenomena which contribute to this demonstration, are dispensed with. Maxwell questioned the validity of the 'second law,' but failed in his attempts to devise a material or real cycle to effect a refutation; and as a last resource, invoked his demon and kinetic theory combination. This particular problem was solved by devising a working medium consisting of a combination of a gas and solid matter; the solid matter being arranged so as to constitute a complete heat engine in itself and having the *peculiar* property of transmuting heat into work by reason of *either* a rise or a fall in temperature. In this manner is produced a working medium which, taken as a whole, is not amenable to the 'second law.'

*The Continuous Method of Steam Calorimetry:* Joseph H. Hart, University of Pennsylvania.

The continuous method of steam calorimetry here outlined is capable of measuring readily latent and specific heats of fluids with a degree of accuracy seldom attained by other methods, even though they be made with the greatest refinement in the method and observations. If a stream

of water at a temperature of $T_1$ be passed through a worm immersed in a steam bath and energies at a temperature $T_2$, the quantity of heat absorbed is $mS(T_2 - T_1)$ where $m$ is the mass of water passed through and $S$ the mean specific heat of water between $T_2$ and $T_1$. If the heat absorbed by the water is obtained by direct condensation of steam alone we have the equation

$$ML = mS(T_2 - T_1)$$

when $M$ is the mass of the condensed water and $L$ the latent heat of condensation of steam. If either $L$ or $S$ is taken as known the other may be readily obtained. Barnes's values of $S$ were taken and a number of determinations of $L$ made to test the efficiency of the method. In the practical development of the method, the process was made continuous. The water in the worm and the condensed water were drawn off constantly and measured. Radiation and conduction entered as important factors in the construction of the calorimeter, but were eliminated or a least satisfactorily accounted for in the amount of condensed water by both theory and practice. Results were obtained in consecutive experiments which were concordant to the fifth significant figure. The value of $L$ which was obtained was slightly lower than Callendar's value of 540.2 calories at 20° C. and points to the existence of a slight constant error.

*On the Thickness of Adsorbed Aqueous Films:* L. J. BRIGGS AND A. W. MCCALL, United States Department of Agriculture.

Parks (*Phil. Mag.*, May, 1903) found the thickness of the aqueous film adsorbed on the surface of glass wool to be $13.6 \times 10^{-6}$ cm. He also calculated the thickness of the film on silica by an indirect method based upon Martini's calorimetric measurements, and obtained the value $44 \times 10^{-6}$ cm.

The authors have measured the thickness of the aqueous film on glass wool, silica and quartz when exposed at 30° C. to an atmosphere five sixths saturated. The substances were kept at constant temperature in a thermostat, and were continually stirred so as to bring the material into thorough contact with the water vapor. The amount of water taken up was determined by drying at 110° C. The surface area was calculated from microscopic measurements. The following values for the thickness of the film were obtained, based upon the assumption that the density of the adsorbed layer is the same as that of the liquid in mass.

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|---|---|
| Silica | $167 \times 10^{-6}$ cm. |
| Glass | $18 \times 10^{-6}$ cm. |
| Quartz | $0.45 \times 10^{-6}$ cm. |

The great discrepancy in the results obtained for silica and quartz indicates that in the case of silica we have something analogous to a solid solution—a conclusion supported by the results of Bellati and Finazzi. It is not improbable that in the case of glass also there is something more than simple adsorption, and that the measurements with quartz give more nearly the true value of the thickness of the adsorption film.

*The Circulation of the Atmosphere, as indicated by the Recent Abnormal Sky Colors:* A. LAWRENCE ROTCH, Blue Hill Meteorological Observatory.

The author urges upon physicists and others in various parts of the world the importance of recording the dates when unusually brilliant sunset glows and the reddish corona around the sun, known as Bishop's rings, are visible, as has been the case intermittently during the past year. These phenomena are probably caused by discontinuous clouds of volcanic dust in

the upper atmosphere, and the author has ascertained that the analogous optical effects were observed in the eastern United States about twenty days later than in central Europe, which, assuming a movement from the west of the dust-bearing currents, indicates an approximate velocity of thirty miles an hour, or considerably less than that of the highest ice-clouds. After the Krakatoa eruption in 1883 the rate of propagation of the volcanic dust from east to west, at a height above the equator calculated from the duration of the sunset colors, was determined with considerable accuracy by a committee appointed by the Royal Society, and it is hoped that sufficient observations will now be collected to enable the velocity of the highest currents above the temperate regions to be deduced equally well.

Dayton C. Miller,
*Secretary.*

## ZOOLOGY AT THE ST. LOUIS MEETING.

Section F of the American Association for the Advancement of Science and the Central Branch of the American Society of Zoologists met in joint sessions at the St. Louis Meeting for the reading of papers, but held separate business meetings. On Monday afternoon, December 28, the address of Vice-President Hargitt before Section F was read by Professor C. C. Nutting, in the absence of the author, the subject being 'Some Unsolved Problems of Organic Adaptation.' Section F was organized with the following officers:

*Vice-President*—E. L. Mark, Harvard University.

*Secretary*—C. Judson Herrick, Denison University.

*Councilor*—A. M. Bleile.

*Sectional Committee*—E. L. Mark, Vice-President 1904; C. W. Hargitt, Vice-President, 1903; C. Judson Herrick, Secretary, 1904–1908. For one year, H. F. Osborn; for two years, S. H. Gage; for three years, C. H. Eigenmann; for four years, H. B. Ward; for five years, Frank Smith.

*Member of General Committee*—Jacob Reighard.

*Press Secretary*—C. Judson Herrick.

Joint sessions for the reading of papers were held on Tuesday and Wednesday, at which the following communications were presented. Titles preceded by an asterisk were presented by Section F; others by the Society of Zoologists.

**The Albatross Rookeries on Laysan:* C. C. Nutting, University of Iowa.

An exhibit of lantern slides after original photographs taken by the author during the Hawaiian cruise of the *Albatross* in May, 1902.

*A Restricted Habitat of Scutigerella immaculata (Newport), together with some remarks on the Animal and its Habits:* Stephen R. Williams, Oxford, O.

In the bed of a small branch of Four Mile Creek, a tributary of the Great Miami River, a comparatively large number of specimens of this little centipede have been found. As far as ascertained the range of this particular group of this species is limited to a part of the bed of this small branch perhaps 600 feet in length. A discussion of the surroundings in general, the precise habitat which the animals seek, some of their observed habits in captivity, and one instance of breeding in confinement, were included. Larvæ have been kept through one molt and certain bodies which may possibly be eggs have been seen.

*On the Analogy between the Departure from Optimum Vital Conditions and Departure from Geographic Life Centers:* Charles C. Adams, University of Michigan.

In a previous paper (*Biological Bulletin*, III., 115–131) the writer briefly discussed some of the criteria which may be used to determine geographic life centers, and certain functional and structural changes resulting from departure from such centers. At the present time attention is called to

other principles involved in radiate dispersal and the significance of these principles in the interpretation of certain ecological laws, habitats and faunal areas. There are certain well-known physiological laws which must be borne in mind. The natural starting point is the vital optimum. Departure from this optimum has a certain definite result. The new vital conditions are a cause of stimulation, and with further departure (beyond a certain limit) lead to increased stimulation or to unfavorable conditions. This results in retarded growth, development and reproduction of the organism as a whole. Thus the end results of extreme departure from the optimum in either direction are similar. In many respects a center of geographic origin is analogous to a vital optimum and any departure from such a center may result in effects similar to those brought about by a departure from the vital optimum, retarded growth, development and reproduction. The results of extreme departures from such a center are also remarkably similar. In view of these relations, many apparently isolated distributional and ecological facts may be correlated.

**A Feature in the Evolution of the Trotting Horse:* Francis E. Nipher, St. Louis, Missouri.

Twenty years ago the author published an equation representing the relation between the speed of the trotting horse and the time measured from any assumed date. The date for the origin of any speed was determined by the rate of increase in the number of horses capable of making that speed. It was, therefore, determined without any reference to the date when some individual horse broke the world's record. The author drew the curve represented by the equation published in 1882, and plotted the observed cases from 1845 to date when the record was actually broken upon the same diagram. The general agreement of these experiments with the curve is very striking. The points representing the observed speed of record-breaking horses are found to group themselves into steps corresponding to generations of the horse. Flora Temple found the horse slow on the computed speed represented by the curve. She put the horse ahead. The same is true of Dexter, of Goldsmith Maid, of Maud S. and of Nancy Hanks. The diagram shows that this evolution of speed is not a continuous operation, but that it goes on in steps or jumps. In 1892 the new sulky with ball bearings made a similar jump in the time of trotting a mile. It is very likely that this advance will also be taken up in time, and will correspond to less radical improvements made in the old sulky before 1892. A photograph of the diagram was exhibited. On the same diagram the performance of the running horse is shown from three widely separated records.

*Further Observations on the Breeding Habits and on the Function of the Pearl Organs in Several Species of Eventognathi:* Jacob Reighard, University of Michigan.

At the Washington meeting of the society the writer described the breeding habits of the horned dace, stone-roller and black-headed dace. In the breeding season the males of these forms possess hard, spine-like thickenings of the epidermis known as pearl organs. The function of these transient structures had been hitherto a matter of conjecture, but it was shown that they are used by the males of some species in their battles with one another and in building their nests, while in the males of all species the chief function of the organs was shown to be that of enabling the male to hold the female during the spawning act. In the present paper

the writer reviewed his work on the horned dace and showed instantaneous photographs of the spawning fish. He described further the breeding habits of the common shiner, in which the function of the pearl organs is essentially the same as in the horned dace. He described also the breeding habits of the back sucker. In this form the spine-like pearl organs occur in rows on the lower half of the sides of the tail and on the enlarged anal of the male. In spawning the female is held by two males, one on either side of her. The rough anals and caudals of the two males press against the sides of the body and tail of the female, and hold her in place. They also press against one another beneath and behind the female, and thus hold the two males side by side. Spawning is accomplished by a rapid vibration of the tails of the three fishes, and during the act the eggs and milt are emitted and mingled with the sand and gravel which have been stirred up.

*Phototaxis in Ranatra:* S. J. Holmes, University of Michigan.

*Ranatra* shows under ordinary circumstances a marked positive phototaxis. Individuals when in the water keep swimming vigorously for a long time in the endeavor to go towards the lightest portion of their environment. When taken out of the water *Ranatras* at first feign death, lying practically motionless for several minutes. If a strong light is moved about near them they come out of their feint much more quickly than when left entirely alone, and soon begin to follow the light with much vigor. The first responses, however, are slight and consist of a small lateral movement of the head when the light is moved from side to side. Shortly after this the animal will respond by vertical head movements as the light is moved back and forth over the long axis of the body. Moving the light around in a circle, the head responds by circular movements of a most regular and precise kind. For every position of the light there is a corresponding attitude of the head. Next following the head reflexes come the reflex movements of the respiratory tube, which becomes raised and lowered coincident with the head as the light is moved to and fro above the body. After a greater or less interval the animal rises on its legs, and if the light is now moved from side to side, the body will perform swaying movements, leaning over strongly towards the side on which the light is held. The legs on the side towards the light are strongly flexed, while those on the opposite side are held in a state of extension. If the light is passed to and fro in a longitudinal direction corresponding swaying movements are likewise performed. When the light is in front, the animal bows down; when it is moved behind, the anterior end of the body is elevated, often at an angle of forty-five degrees. Moving the light around the animal in a circle, the body follows with corresponding motions. These responses are so regular and definite that one might almost tell what particular attitude of the body, legs and head will be assumed for a given position of the light. Light in *Ranatra* apparently produces a powerful effect upon the tension of the muscles and may be made to control the behavior of the creature in a most precise and arbitrary manner.

**Studies on Protoplasmic Structure:* A. W. Greeley, Washington University, St. Louis.

The influence of chemical, electrical, thermal and osmotic stimuli upon the protoplasmic structure. The effect of these variations in structure upon the elementary vital phenomena, with special refer-

ence to the chemotropic and galvanotropic reactions.

*Amitosis in the Embryo of Fasciolaria:* Henry Leslie Osborn, Hamline University, St. Paul, Minnesota. (Read by title.)

Very early embryos of *Fasciolaria* exhibit amitosis, a fact of interest because direct nuclear division is seldom seen in embryos. The embryos are in the gastrula stage, the various organs of the head, foot and visceral regions not yet having begun to put in an appearance. The *Fasciolaria* embryo is very peculiar in being greatly dilated by the large number of primitive ova which it has swallowed to serve as food. Each of these ova is a large mass of small yolk grains enclosed by a distinct cell wall and permeated by cytoplasm containing nuclei. The endoderm is composed of cubical cells in which one sees nuclei in all stages of direct division. In addition to the ordinary form of amitosis, one also sees here certain very large nuclei, constricting at various points as if in an act of giving rise to nuclei by gemmation. Mitotic figures are also seen in the endoderm. A part of the endoderm of the embryo soon becomes much enlarged and vacuolated, and is evidently the seat of active secretory processes connected with the digestion of the yolk. The amitosis can thus be considered as coming in line with Ziegler's view that it is an accompaniment of secretory activity in the cells, but it is not in accord with that part of his theory which attaches amitosis to cell senescence. The embryo possesses peculiar external organs, the larval kidneys, which gradually assume a large size, though purely provisional structures. They lie directly under the velum and are made up of ectodermal cells swollen to huge dimensions by the accumulation within them of a homogeneous, faintly-staining material. It is generally supposed that these are excretory organs. In the outer ends of the cells one finds strong indications of amitosis. Here, of course, amitosis is occurring in cells which, though an important part of the body of the larva for the time being, are in reality secretory cells and not destined subsequently to give rise to new cells. Nuclear divisions are found in the food-ova, which are plainly degenerative, and the ova soon after break up and lose their identity altogether. These nuclear divisions appear to be amitotic. They are clearly connected with cell senescence.

**On the Morphology of Artificial Parthenogenesis in the Sea-urchin, Arbacia:* S. J. Hunter, University of Kansas.

The unfertilized eggs of *Arbacia* subjected to the influence of sea water concentrated by evaporation to three fourths its normal volume for about two hours may, when transferred to sterilized sea water, develop into free-swimming plutei. The subsequent behavior of the eggs is dependent upon the stage of maturation attained when placed in the concentrated solution. Both cytoplasm and nucleus are concerned in development. Eggs isolated and placed under continuous observation until blastulation at first become amœboid, nuclear division following, sometimes repeated several times before cleavage of cytoplasm occurs. Cleavage is not total nor progressive, partial or complete fusion of blastomeres intervening. Cleavage prior to blastulation is at no time comparable with normal processes. Different embryos show wide variations in character of external changes. At blastulation ectoderm cells are formed over large cells, generally three in number. The blastula does not become ciliated and free-swimming before nine hours. Mesenchyma cells are thrown off from the vegetable pole into the blastocœle. The amœboid activity spoken of begins at

about the time of first cleavage in normal fertilization, the rate of development falls gradually behind the normal, being in specific cases as 2:3 at the moment of active swimming, and 1:2 in time of development of pluteus. The artificial gastrulæ are less symmetrical and less active than the normal forms. The pluteus three days old, by measurements, equals in size the normal pluteus a day and half old, differing in lack of symmetry and poorly developed skeletal spicules. Mouth, œsophagus and stomach are present, but no anal opening has been noted. Development in fused fragments is similar to that of the whole egg, except that no fusions are known to have become plutei. No membrane appears, but a perivitelline membrane surrounds eggs placed in a solution composed of 50 cc. of $2\frac{1}{2}$ *n* $MgCl_2$ solution and 50 cc. of sea water for from one to two hours. The same effect, though in not so great a percentage of eggs, is obtained by use of $2\frac{1}{2}$ *n* NaCl solution in same proportions.

The primary nucleus equals in size and eccentric position in egg (as revealed in sections) the nucleus of oötids measured in sections of the ovary. The nucleus advances to the center, enlarges. A small aster with central dark body (parthenocentrosome) appears in contact with exterior of nuclear membrane. This divides to form the amphiaster. The various phases of mitosis ensue. The chromatin nucleolus contributes to formation of chromosomes. These are between twelve and fourteen in number. In a few cultures the nucleus was amœboid in movement and amitotic in division. From such cultures no larval forms developed. Both cleavage asters and cytasters contain central bodies similar to centrosome of fertilization. These bodies appear to be formed *de novo,* and in the case of the cleavage asters there is evidence which suggests that their origin may be in the second polar body. Cytasters appear to divide and are sometimes centers of cleavage. They are more abundant in oötids placed in the concentrated solution. Nuclear division is not necessarily followed by cytoplasmic cleavage. Cleavage of the cytoplasm is preceded by nuclear division.

**Biological Interpretation of Skew Variation:* Frank E. Lutz, University of Chicago. (Read by title.)

A departure from the 'normal' curve of biological measures may be brought about either (1) by removal of a number of individuals from one side of the mean, (2) by increase of individuals or (3) a combination of the two. In skewness caused by removal, we have, in the sign of the skewness, a prophecy of the direction of variation. In skewness caused by the starting of a new race about a mean within the range of the old race, skewness would be prophetic at the beginning of evolution and historic at the end. The distance between the two means is a factor determining the uni- or bi-modality of the combination curve. Skewness as the result of both addition and removal seems too complicated for present analysis. And in no case have we, at the present time, enough data to interpret definitely, in any particular case, the significance of skew variation.

*The Correlation of Brain Weight with other Characters:* Raymond Pearl, University of Michigan.

**The Relation between the Law of Ancestral Heredity and Mendelianism:* Frank E. Lutz. (Read by title.)

The 'purity of the germ' idea applies quite as well to the law of ancestral heredity as to Mendelianism and is in harmony with it. The confusion seems to have arisen because of the difficulty in distinguishing between the different grades of intensity of the characters used in certain

lines of work. If we suppose four males, having conditions of the character in question, which we may represent as *ab*, *ef*, *ij* and *nm*, borne by their germ cells, to mate with four females bearing this character in the conditions *cd*, *gh*, *kl* and *op*; and if we mate their successive generations, we shall always get the old Galtonian formula. If, however, we suppose the conditions of the character, which we have represented by various letters as borne by the males, to be indistinguishable *inter se*, so that we may represent them all by $x$; and, likewise, those of the female by $y$; and if we then go through the same hypothetical mating as above, we get the Mendelian formula. It would be dangerous to insist upon a strict adherence to 'purity of the germ.' External and internal factors undoubtedly influence it. It is also improbable that a case could be found in which, by careful work, gradations of the character in question could not be found. We would, therefore, conclude that the Mendelian school arose either by an unfortunate selection of data (taking something in which the variations of the character were hard to perceive and measure), or by a careless handling of the data used.

*Evolution without Mutation:* C. B. Davenport, University of Chicago.

While recognizing that mutation is an important factor in evolution, the author finds, from a statistical study of geographical and paleontological series, that the transitions between species of the scallop (*Pecten*) may be graduated, and of the order of individual variations. Thus the Pectens from Cape Hatteras are intermediate in their qualities between those from Cold Spring Harbor, Long Island, and Tampa, Florida.

Also the fossil *Pecten ebonus* of the Pliocene Nansemond River (Virginia) beds taken from the lowest to the highest beds leads in a uniform series towards the recent *P. irradians* of North Carolina.

**Studies in Compensatory Regulation:* Charles Zeleny, University of Chicago.

The ontogenetic development of the opercula in the serpulid *Hydroides* corresponds very closely with the probable phylogenetic development. The regeneration, however, does not agree with the ontogeny. In both ontogeny and regeneration there is a close correlation between the two opercula, and each side has the potentiality of forming a functional operculum. When one side has a lead in development at the start it restricts the other to a rudimentary condition. When both have an equal start two functional opercula develop. A similar close relation between organs is shown in other cases. In the serpulid *Apomatus* after removal of the branchiæ and opercula, the differentiation of the new opercula is much more rapid when the posterior region of the body is also cut off than when this region is uninjured. In the decapod crustaceans *Gelasimus* and *Alpheus*, when both chelæ are thrown off the animals pass through the succeeding molts sooner than when no chelæ, or only one, is removed. Finally, in the ophiurid *Ophioglypha*, the rate of regeneration of the arms is greater the greater the number of removed arms, with the exception of the case where all are removed.

*Iridescent Feathers:* R. M. Strong, Chicago, Ill.

**Study of Cross-sectional Courses through the Brain with Cortex Surface Relations by Aid of Fuller Sections and Models:* Charles H. Hughes, St. Louis. (Read by title.) To be published in *The Alienist and Neurologist.*

*The Morphology of the Vertebrate Head from the View-point of the Functional*

*Divisions of the Nervous System:* J. B. Johnston, University of West Virginia. (Read by title.) To be printed in the *Journal of Comparative Neurology and Psychology.*

*The Vascular System and Blood Flow in Diplocardia communis Garman:* Frank Smith and J. T. Barrett.

*Diplocardia communis* is a species of large earthworms that are abundant in Illinois and that have a vascular system which may be profitably studied for the light thrown on disputed points concerning the blood flow of other species. Posterior to VI. the dorsal vessel is double in each somite. In IX. to XIV. there is a distinct supra-intestinal vessel which at its extremities joins the vascular plexus of the œsophageal wall and is connected with it by several short branches in each of the somites X., XI. and XII. There is nothing peculiar about the ventral vessel. A subneural and lateral-neurals are absent. A pair of lateral-longitudinal vessels connects anterior capillaries with the œsophageal plexus of somites IX. to XIII. inclusive. From it they extend outward to the body wall and posteriorly along the latter in the clitellar regions (XIII.–XVIII.). Three pairs of dorso-intestinal hearts in X.–XII. force blood from the dorsal and supra-intestinal into the ventral. Paired dorsal hearts in V.–IX. force blood from the dorsal into the ventral. In each somite posterior to XX. one to three intestino-tegumentaries connect the intestinal wall with each dorso-tegumentary at points near the body wall. Observations of pulsations and of the results of clamping and cutting vessels have led to conclusions of which the following is a brief summary: In *D. communis* the blood flows anteriorly in the dorsal; anteriorly in the ventral in front of the hearts and posteriorly back of them; posteriorly in the lateral-longitudinals into the œsophageal plexus of IX.–XIII. and then partly into the supra-intestinal and partly to the clitellar regions. Blood flows outward from the ventral through ventro-tegumentaries to the body wall, nephridia, nerve cord; and through ventro-intestinals to the intestine. Blood flows into the dorsal from the intestine through the dorso-intestinals and from the body wall, nephridia, etc., through the dorso-tegumentaries. Through the intestino-tegumentaries blood flows from the integument to the intestinal wall. These results closely accord with those of Johnston and Johnson on *Lumbricus terrestris* as far as the vessels correspond, and differ materially from those of other observers on that and other species.

**The Diffusion of North American Hawk Moths:* F. M. Webster, Urbana, Illinois.

The paper shows the probable northern trend of diffusion from the tropics through the Antilles into Florida, and through Central America and Mexico into the southwestern and Pacific Coast states, or from Honduras into the West Indies and thence to Florida, and their diffusion from these points of entrance into the United States over North America.

**Insect Life above Timber Line in Colorado and Arizona:* Francis H. Snow, Lawrence, Kansas. To be published in the *Kansas University Science Bulletin.*

This paper calls attention to the difference in the character of insect life in the two locations. In Colorado the species above timber are generally peculiar and, for the most part, not found below timber line. In Arizona the species above timber line do not differ from those below timber line. Illustrations are given. The reason suggested is that the glacial ice mass did not extend to the Arizona summits.

**The Salmonidæ and Thymallidæ of Alaska:* Barton Warren Evermann, Washington, D. C. (Read by title.)

The total number of species of Salmonidæ now known from Alaskan waters is 17, distributed among genera as follows: *Coregonus,* 3; *Argyrosomus,* 3; *Stenodus,* 1; *Oncorhynchus,* 5; *Salmo,* 3; *Cristivomer,* 1, and *Salvelinus* 1. Of the closely related family of Thymallidæ there is one species, *Thymallus signifer.* This number is much greater than is known from any other region; and as regards the number of individuals of important species of Salmonidæ, there is no other region that approaches Alaska. The Pacific salmons (of the genus *Oncorhynchus*) are by far the most abundant, one or more of the five species literally swarming in every suitable stream at spawning time. These are all anadromous fishes, spending the greater part of their lives in salt water, entering fresh-water streams only for spawning purposes. Immediately after spawning all the individuals of Pacific salmon, of whatever species, die, none surviving the spawning act and none ever returning to the sea. The eggs do not hatch until several weeks or even months after the fish that produced them have died, and, therefore, no Pacific salmon ever saw either its offspring or its parents; the generations never overlap. While many of the facts in the life histories of these salmon are now well known, there are many others which remain to be worked out. The Bureau of Fisheries is now taking steps looking towards a careful and thorough study of the salmon streams of Alaska and the life histories of the various species of salmon. During the recent investigations of the Alaska Salmon Commission many important facts were determined regarding these fishes. Much new information was secured regarding the habits and distribution of the Dolly Varden trout and the cut-throat trout, and the presence of a species of rainbow trout in southeast Alaska was first made known. A fine series of specimens of the fishes of the upper Yukon, including the Arctic grayling, was also secured.

**Preliminary Description of a New Family of Gymnoblastic Hydroids from the Hawaiian Islands:* C. C. NUTTING, University of Iowa. To be published in connection with a report on the hydroids of the Hawaiian cruise of the *Albatross,* U. S. Bureau of Fisheries.

*The Development and Relationships of the Rugosa (Tetracoralla):* J. E. DUERDEN, University of Michigan.

The paper gives: (1) A brief historical account of the various theories which have been held with regard to the nature and relationships of the extinct group of corals, the Rugosa or Tetracoralla; (2) the conclusions of the author from the examination of a large number of species in the light of more recent results on living Zoantharia. At different times the Rugosa have been supposed to be related to the Hydrozoa, Ceriantheæ, Alcyonaria, Scyphomedusæ and modern hexameral corals. The last view prevails mostly among English writers, the distinctness of the group being maintained by most German and French authors. The present investigations have been carried on mainly by the method of grinding down of individual coralla, each successive stage in the growth being drawn as it appeared. In this way the complete development and relationships of the septa have been established. In every instance where the perfect tip has been preserved a cycle of six septa is found to occur, thus demonstrating the primary hexameral relationships of the Rugosa as contrasted with the tetrameral usually assumed. The subsequent septa appear in only four of the six primary chambers and in a manner differing altogether from that in modern corals. The conclusions reached are that the Rugosa must remain as a distinct group of the Zoantharia, related in their proto-

septal stage to modern corals and actinians, but later developing in an altogether characteristic manner. Of modern forms they are most closely allied to the zoanthids, which are without any true skeleton; in these the growth of the mesenteries takes place in a manner comparable to that of the septa in the extinct forms, though proceeding in only two of the six primary chambers.

*Demonstration of Preparations made during a Study of the Life-history of the Cestode Crossobothrium laciniatum (Linton):* W. C. CURTIS, University of Missouri.

**The Types of Limb Structure in the Triassic Ichthyosaurs:* JOHN C. MERRIAM, Berkeley, California. To be printed in *American Journal of Science.*

The limb structure in the Triassic ichthyōsaurs shows generally a much stronger resemblance to the type of extremity found in the primitive shore forms of the reptilia than is seen in the Jurassic forms. The limbs of Triassic ichthyosaurs show as great a degree of differentiation as is found in the later types. Two fairly definite lines of evolution are noticeable in the paddle structure of the Ichthyosauria, one leading to the broad-paddled Latipinnati, the other leading to the Californian Triassic genera and to the narrow-paddled Longipinnati.

**A New Group of Marine Reptiles from the Upper Triassic of California:* JOHN C. MERRIAM, Berkeley, California. To be printed in 'Publications' of the University of California.

Marine saurians with abbreviated limbs and slender, elongated snout. External nares median. Temporal arcades slender. Dentition heterodont, posterior teeth flat, anterior teeth slender, conical. Elongated vomer with two rows of flat teeth. Pterygoid (?) with numerous slender conical teeth. This group stands in somewhat the same relation to the typical Rhynchocephalia as that which the Pythonomorpha bear to the Lacertilia. Evidently derived from primitive land or shore rhynchocephalians, it has taken somewhat the same course in evolution as that followed by the ichthyosaurians and parasuchians. From both of these groups it differs very considerably in the structure of the vertebræ, limbs and skull. It is sharply separated from both by the characters of dentition. The name Thalattosauria has been used to designate this group.

*An Anomaly in the Arterial System of the Dog:* JOHN C. BROWN. (Introduced by H. F. Nachtrieb.)

The right subclavian artery arises from the dorsal aorta beyond the origin of the left subclavian artery and passes dorsad to the œsophagus and trachea before reaching the right fore limb. The right fourth branchial arch is entirely wanting.

*The Brain and Nerve Cord of Placobdella pediculata:* Illustrated by wax models made after the Born method by E. E. HEMINGWAY. (Presented by Professor Henry F. Nachtrieb.)

*Placobdella pediculata* Moore is a new species of leech parasitic in the gill chambers of the sheepshead. The description of this leech has not yet been published, but will appear in connection with Mr. Hemingway's account of the anatomy of the animal. In general the results of Mr. Hemingway's work confirm the conclusions reached by Whitman for *Clepsine hollensis* and other species. The models represented the brain, the ganglion of a typical somite and the posterior mass of ganglia.

*The Mechanism of Feeding and Breathing in the Lamprey:* JEAN DAWSON, University of Michigan. (Presented by Jacob Reighard.)

It was shown that there is no good evidence that lampreys feed except when attached, and that, according to accepted accounts, they breathe when free as when attached, through the external branchiopores. There is thus apparently no occasion for a backward current of water into the mouth, either for the purposes of respiration or for the purpose of feeding, and the published observations and those of the writer show that such a current is of rare occurrence. It would thus appear that the velar valves, water tube and valves of the external branchiopore must serve chiefly for the purpose of enabling a current of water to be directed forward out of the mouth. It was shown that such a current is directed forward whenever the animal cleanses the pharynx or mouth of irritating foreign bodies and whenever it detaches itself. Synchronously with the forwardly directed current there is a closure of the external branchiopore by means of the ectal and ental valves described by Gage. Hence water tube, velar valves and ectal and ental valves of Gage find their explanation chiefly in this forwardly directed current. There was also described a pair of jaws—the velar jaws, connected with the velar valves. These jaws serve to hinder the entrance of foreign bodies into the water tube, and are so arranged as to close when the water tube closes by the action of the velar valves, and to open when the water tube opens through the relaxation of the velar valves. It was shown further that the attached lamprey feeds not only on the blood of its host (as stated by Gage), but also on its soft tissues.

**Some Reactions of Mnemiopsis leidyi:* George William Hunter, Jr., New York City. (Read by title.)

*Geotropism.*—The animal becomes positively or negatively geotropic under conditions seemingly intimately associated with the given supply of light and degree of temperature. *Stereotropism.*—*Mnemiopsis* exhibits marked stereotropism, especially in the darkness. Large numbers of animals will frequently be found resting in pockets in the eel-grass. They also exhibit this same phenomenon in dishes in the laboratory. *Reactions to Light (Phototaxis and Photopathy).*—Sudden light causes activity; sudden darkness inhibits activity. (This is partly in harmony with the findings of Yerkes on *Gonionemus.* See *American Journal of Physiology,* IX., No. 5.) Orientation with reference to the directive influence of the light rays (phototaxis) was long sought for, but only obtained in a few instances, with very strong or focused sunlight. A large number of experiments were made in dishes covered with strips of red, blue and green glass. It was found that in a given period of time (one to ten hours, observations made every half hour) the greater number of animals were counted under the green glass. The totals from 5 sets of experiments read as follows: Blue, 90; red, 126; green, 235. These results need much more careful study before an explanation is offered. *Effects of Changes in Temperature.*—*Mnemiopsis* is relatively more resistant to changes in temperature than is *Gonionemus* (see Yerkes, *American Journal of Physiology,* Vol. IX., No. 5). Responses to electrical stimulation under condition of decrease of heat show little change in reaction time to 15° C.; lower than that a gradual increase in reaction time until no reaction is reached. Responses to electrical stimulation under conditions of increase of temperature show a slight quickening in the reaction time up to about 29° C. After that a rapid increase in reaction time. *Electrotaxis.*—A definite orientation of the animal is the immediate effect of stimulation with a current of moderate strength (one half to three volts, voltage taken in

dish of water about one inch from the electrode). The body is turned so that the long axis comes to lie approximately in the direction of the current, the aboral end is directed toward the anode, and the animal moves with more or less rapidity (depending upon the strength of the current) to the cathode. With a very weak current the animal may simply orient itself without movement towards the cathode. Still weaker stimulation may simply cause slight muscular contraction and movement of cilia without orientation. Reversal of current causes reversal in the orientation of the animal and reversal in the direction of its progression. The immediate cause of the change in direction of the animal is a reversal in the direction of the beat of the ciliated paddle-plates. In general, these may be said to beat more strongly in the direction of the anode. But orientation is brought about by more vigorous beating of the plates in certain regions of the body—possibly more strongly in the more direct lines of current. Muscular action also aids in orientation and in locomotion. Observations on the action of cilia and muscles under the induced current were also made, but are too incomplete for present notice.

**Mouth Parts and Oviposition of Gall-producing Insects:* Mel. T. Cook, De Pauw University.

Gall-producing insects have two methods of depositing eggs, *i. e.*, on the surface of the plant and within the tissues. In the case of the hymenopterous insects, the eggs are placed within the tissues of the bud, the incipient shoot or in the undeveloped leaves of the bud. There is no indication of chemical stimulus. The gall forms after the hatching of the larva and is probably due to the stimulus from the mouth parts of the larva. The mouth parts are of two forms, those for sucking and those for biting. The strength of the mandibles varies with the firmness of the gall. The stimulus is due to mechanical irritation.

**The Bermuda Biological Station for Research:* E. L. Mark, Harvard University.

**A Theory of the Histogenesis, Constitution and Physiological State of Peripheral Nerve:* Porter E. Sargent, Cambridge, Massachusetts. (Read by title.) To be published in the *Journal of Comparative Neurology and Psychology.*

**The Two Chief Faunæ of the Earth:* Alpheus S. Packard, Brown University. (Read by title.)

From the recent studies on the distribution of several groups of moths, I have been led to review the recent work and views of those who advocate the former connection between South America and Africa, and the possible connection of the southern land-masses with Antarctic land. There seem to be two main centers of origin, *i. e.*, two chief zoological areas—that of the northern and that of the southern continents. To the former Huxley's name, Arctogæa, is by general consent applied. For the southern area Sclater's name, Antarctogæa, may be employed. Indeed, we had thought of this term before learning that the name had already been suggested. Although Gadow extends the term Notogæa so as to embrace the three southern continents, yet it seems preferable to confine it to its former limits. The Antarctogæan area thus includes what are regarded by Blandford, Lydekker and others as two separate realms, *i. e.*, Neogæa (South and Central America) and Notogæa (Australasia, Polynesia and Austro-Malaysia), while Africa south of the Sahara was regarded as a region or dependence of Arctogæa. The opinion, however, that the form and distribution of the continents were very different in past ages from what they are now is gaining ground. Thus northeastern America and western

and central Europe seem to have been more or less connected during and since the Cambrian period, with intermigrations of life-forms. This connection, with probable interruptions, appears to have continued down to the early centuries of the Quarternary. Also, from what little we know of the extinct animals and of the present relations of the plants and animals of the continents south of latitude 20° north, several observers have been led to suppose that these continents were more or less intimately united, and that possibly there were land connections with a former Antarctic continent. From maps, though naturally very hypothetical, published by de Lapparent and Koken, showing the probable distribution of land during the Middle Devonian, South America, Africa, southern Asia and Australia were possibly connected. Towards the end of the Carboniferous period there was probably a more or less continuous extent of land over what is now South America, Africa and Australia. This land connection between what are now separate continents appears to have persisted through the early Mesozoic age (Trias and Jura), though towards the end of the Jurassic Australia became widely separated by the Indian Ocean from Africa, while South America and Africa remained united. Our studies on the distribution of Neogæic and African (Ethiopian) Ceratocampidæ and two related families point to a connection in Cretaceous or early Tertiary times between Brazil and western Africa, thus bearing out the views of Ihering, Gill, Ortmann and others. The former connection of these Antarctogæic continents (whatever may be said of their possible connection with Antarctica) is borne out by the well-known facts in the distribution of certain terrestrial worms, land and fresh-water mollusks, insects, fresh-water fish, Dipnoi, *Peripatus*, amphibians, reptiles, birds and mammals. Our results also suggest that Africa south of the Sahara should properly be regarded as a zoological realm (for which the word Afrogæa is proposed), and not a dependence or region of Arctogæa.

C. JUDSON HERRICK,
*Secretary.*

## AMERICAN SOCIETY OF ZOOLOGISTS, CENTRAL BRANCH.

THE first annual meeting under the present organization was held at St. Louis, December 29 and 30. The following officers were elected for the ensuing year:

*President*—Professor C. H. Eigenmann.
*Vice-President*—Dr. S. J. Holmes.
*Secretary and Treasurer*—Professor F. R. Lillie.
*Additional Members of the Executive Committee*—One year, Professor G. A. Lefevre; two years, Professor T. G. Lee; three years, Professor Herbert Osborn.

The titles and abstracts of the papers presented appear together with those presented by Section F of the American Association for the Advancement of Science, in Professor Herrick's report printed above.

FRANK SMITH,
*Secretary.*

## SCIENTIFIC BOOKS.

*Evolution and Adaptation.* By THOMAS HUNT MORGAN. The Macmillan Company. 1903. Pp. 470.

The modern evolutionist is obliged to confess, and somewhat painfully, that the processes connected with 'Darwinism' continue to receive different and conflicting explanations—this, too, in the face of a mass of documents which an ever-increasing number of investigators have been bringing together during the past decades. In token of this lack of concord in interpretation witness two volumes, not mere tracts, which have lately appeared. In the first of these, Plate,* following Darwinian

* 'Ueber die Bedeutung des Darwin'schen Selectionsprincips und Probleme der Artbildung,' Zweite, vermehrte Auflage, 1903, Engelmann, pp. 247.

lines, does not hesitate to declare that 'for the harmony which exists between the living conditions of organisms and their morphological and physiological characters there is at the present time no other scientific explanation than natural selection.' In the second book, on the other hand, Morgan is firmly convinced that as a means of accounting for adaptations the doctrine of selection is largely to be discarded. Morgan represents the newer school of evolutionists, and from this standpoint his book has a timely value, for it is the first non-technical work of its kind. Whether he proves his case satisfactorily—for the work is *parti pris* throughout—is a question which each critic must answer. But all will agree that his work will find its place on the general bookshelves side by side with the volumes of Romanes, Lloyd Morgan, Spencer and Wallace.

Morgan, as he states in his preface, was early led to a belief in the inadequacy of natural selection from his studies upon regeneration, for this process often concerns itself with structures which play no part in strict Darwinism. The author now aims to explain some of these difficulties by mutations.* Thus, keeping in mind especially the results of De Vries, Morgan emphasizes the probability of mutations having occurred broadcast under infinite conditions of manner, degree, place and time. Such mutations produced series of creatures which were suited or unsuited to their particular locality, or were perhaps indifferent. Some, like *Kallima,* were even better adapted to their neighborhood than necessity for survival demanded; others were imperfectly adapted, but surviving in spite, *e. g.,* of bright colors, asymmetry or complicated reproductive processes. According to such a doctrine of mutations organic forms succeed one another kaleidoscopically, their variability becoming largely arrested between the definitely marked periods of change. Thus, if a species be compared to a facet upon which a polyhedron is balancing, the species, like the facet, may oscillate within definite limits. But if the limits of variation are transcended, the entire polyhedron changes its position and comes to equilibrium on a new facet. This plan of variation forms the undercurrent of Morgan's philosophy; through it he sees appearing structures, forms and habits, which have no 'selective value,' their purpose or utility may be partly or wholly *nil,* 'for we can not measure the organic world by measure of utility alone,' yet they appear as perfectly and as plentifully as the crystal-forms of snow. Granted then a galaxy of mutations some of them will fit their surroundings with marvelous accuracy. And with this in mind Morgan develops what he believes is a probable answer to many of the puzzles of shape and symmetry, the mutual adaptation of colonial forms, degeneration (those mutations only surviving which 'we may almost say, have been forced' into a parasitic environment, 'for these degenerate forms can only exist under such conditions'), coloration, life-length, regeneration, individual adjustments, secondary sexual characters and even of sex itself.

* The Lamarckian hypothesis is given little importance: 'I am not sure that we should not be justified at present in claiming that the theory is unnecessary and even improbable.'

It is obviously impracticable for a reviewer to consider more than the barest outlines of a work which touches many fundamental viewpoints. Each of the dozen chapters of the present book contains enough to warrant separate reviews and reviewers. And each critic will find little trouble in pointing out some of the many 'pitfalls' referred to in Morgan's preface. For discussions in evolution have long since shown that facts may be read in different ways.

There are general features in which the present volume deserves warm praise, as in providing a mass of helpful examples, and in urging attractive arguments against many 'purposeful' or 'useful' variations, and above all things in considering critically the doctrine of sexual selection, furnishing against the latter—in spite of lack of reference to Cunningham's work—the most serious objections hitherto given. There are other features, however, in which improvement might well have been made. Regrettable is a general dearth of exact references—there are, in fact, not a dozen citations in all. And especially regrettable, in view of the scope of the

book, is the total absence of treatment of vitalism, which, as all admit, has become too troublesome a specter to be ignored in problems of adaptation. Regrettable is this omission, none the less, since there are few authors in a better position than Morgan to summarize the strongest arguments of the neovitalists. Altogether the book would have been more valuable, it seems to me, if the author had readjusted somewhat his themes; he might thus have included a discussion of vitalism, amplified his section on Naegeli's 'perfecting principle,' and given a more adequate account of orthogenesis, respects in which the work is not to be mentioned in terms of Plate's, and by the same token abridged his discussion of natural and artificial selection. As it stands, the work gives page after page quoted from Darwin—indeed, throughout the entire book there are over a hundred pages in quotation marks. This extended treatment of the classic aspects of selection, we freely admit, led us to the false hope that the newer theme of organic selection, as set forth by Osborn, Lloyd Morgan and Baldwin, would at least be given definite reference.

As already remarked, each reviewer of a work of the present broad scope will find abundant ground for criticism. The most formidable and most pertinent discussion might easily arise over mutations themselves. Morgan, like Korschinsky and De Vries, holds that mutations are saltations by which new 'modes' are established in organisms, while variations, in the sense of the usual selectionist, are changes occurring about the same 'mode.' But we find that Morgan is willing to go further, and embrace under the term mutation all discontinuous variations. And if this point is granted, I confess that I can not see that his standpoint is widely different *in esse* from that of the rank and file of latter-day selectionists. For after all discontinuity in variations is a question of degree, and it would not be a serious matter to show that transitions occurred between discontinuous to continuous variations. A case, one which I happen at the present moment to be interested in, occurs in the development of *Chimæra*. In the fertilization of this form supplemented spermheads, as they pass into the egg, divide at once amitotically. And we have thus what appears at first sight a distinct saltation from the usual conditions in polyspermy. Comparing, however, *Chimæra* with the conditions in the allied sharks, we find that this peculiar behavior of the sperm nuclei is not a feature which has arisen as a discontinuous variation; it represents nothing more nor less than an abbreviated process of what occurs in the more primitive sharks; in these forms amitosis in sperm nuclei appears at the end of a graded series of nuclear divisions, a series at one end of which mitosis occurs, and at the other amitosis. In the development of *Chimæra* the earliest stage of the sperm nucleus thus corresponds to a late stage in the sperm nucleus of sharks, and thus we conclude that the discontinuous character in *Chimæra* is not a new 'mode,' but a modified phase of a simple continuous process. This example, be it understood, occurs not immediately between offspring and parent, but, like 'mutations' in paleontology, between offspring and early ancestor, but it seems to me that a typical mutation differs from it in degree rather than in substance, and that similar processes may combine to form the complex of wonderfully adjusted discontinuous variations which we call a typical mutation. I incline to the belief that, in the elaboration of the doctrine of mutations, Morgan, like some other transmutationists,* keeps too prominently in the foreground not the strands which make up the complicated web of adaptation, but the mutant as a whole, picturing not the few details of structure which our present knowledge enables us to grasp, but a progression of brilliant, perfectly formed organisms, delicate in internal adjustments and *new*, different from their parents, indeed, even from their earliest stages, a picture which, as Morgan says of Naegeli's progression 'has a grandeur that appeals directly to the imagination.' On the other hand, admitting that discontinuous vari-

* Morgan substitutes 'transmutation' for 'evolution,' adjusting the term more closely, therefore, to his interpretation of the process. If terms are to be shifted, why should not the Lamarckian 'transformism' be revived?

ations ('mutations') are in themselves but adaptations of continuous variations, and bearing always in mind that extreme mutations are numerically rare, and, in our present knowledge, obscure as to fate, I take it that we are hardly in a position to give them supreme importance in the economy of species-building. Of extreme interest they are, none the less, and from theoretical standpoints, they are worthy of the most painstaking research, and are not to be discredited as mere 'freaks' or 'sports' important only in the praxis of gardening, as Plate concludes. There is, furthermore, a feature of mutations which has, it seems to me, never been adequately considered, *i. e.,* the definiteness of their characters, a feature which tells rather in favor of orthogenesis than the less definite interpretation which Morgan supports. For in all mutations—we refer to typical cases—the creature which appears is constant to a remarkable degree; the peacock mutant is the black-japanned, never the yellow- nor the red-, and even when many mutants appear 'simultaneously' they are surprisingly constant in characters. The word orthogenesis, by the way, does not occur in the index, and in similar instances we find that the index is troublesomely brief.

It is, I conclude, as a postulate of his doctrine of mutations that Morgan attacks our venerable recapitulation (or, as he prefers to call it, *repetition*) theory. For when a mutation does occur it appears literally *ab ovo,* although the author does not commit himself as to the exact point at which the '*presto change*' occurred, whether in fertilization or segmentation, but, if I understand him aright, it occurred during earliest development; nor does he say concretely whether all mutants date from an identical stage. But the drift of his remarks on recapitulation leads us to infer that they do, for otherwise this chapter seems to lose its point. For, outgrowing the days of Oken, no author of good repute has maintained that the *adult* structures of ancestors are still present in embryos, nor that the embryo chick resembles an *adult* reptile, nor even that the embryo of one species is ever exactly identical with the embryo of the corresponding stage of the nearest species. We might even go further and assert that no modern zoologist has maintained that even within the same species any individual is absolutely identical with any other individual at any corresponding stage, early or late, in growth. Even the enthusiast who substituted a cut of an embryonic dog for one of man, and cheerfully admitted the imposture on the ground that the figures were equivalent, has never been charged with believing that the stages *were* equivalent, but only with crudely illustrating an elementary text-book, and with unscientific levity. Morgan's therefore must imply something more than the doctrine of von Baer—which was to the effect that chick embryos resemble (he does not say are absolutely identical with) embryos of lizards, and that the stages of chick and lizard correspond during a longer period of development than do embryos of chick and fish. And I have gathered what I believe is his meaning only piecemeal, through his references to larval forms, his assertion that 'jumps, or short cuts, of the developmental process are unknown in the physiological process of development,' and his quotations regarding the early appearance of mutational characters in the development of birds and dogs. He entirely fails to appreciate, it seems to me, the part played by adaptation at all stages of growth.

A final word regarding useful variations. Morgan maintains (and we believe that the majority of zoologists are in sympathy with such a view as opposed to Wallace's) that many 'useful' characters in organisms are useless and accidental, even although, *a priori,* the case appears adapted to purpose in marvelous detail. We smile at the silhouetted skull on the back of a moth, or the head of the drowned Taira warrior on the carapace of a Japanese crab, or the profile of a Scandinavian face on the 'earbone' of a Norwegian whale, but are these complicated coincidences more accidental than some of the 'purposeful' variations which we accept rather on the faith of coincidence than upon actual proof of utility? Facts are clearly what we need before we can assert that definite characters or variations are useful—but it is equally true

that facts must be cited before many of the stock examples of 'useful adaptations' can be cast out. And from this standpoint a number of Morgan's examples of non-useful adaptation fail to convince. Thus, why may not the different colors in the mouths of the male and female hornbills be useful in sexual selection? Morgan assures us that these differences in the colors are useless since they can not be seen, but on the other hand, from what we know of the habits of huge-billed birds, it is quite possible that during nuptial antics the bills are widely open. Again, Morgan admits that the green color of a frog is probably useful, but believes useless the black pigment lining the body cavity. He does not show that it *is* useless, in spite of our lingering suspicion that a black screen behind a thin body wall might well be useful in collecting warmth, or even in protecting from light delicate viscera. So, also, we are not convinced that gray hair and retreating chin are altogether useless organs, for it is quite possible that there is some foundation for the popular belief that they are adverse to sexual sentiment, and may thus, after all, play a useful part in selection.

BASHFORD DEAN.

## SCIENTIFIC JOURNALS AND ARTICLES.

*The Journal of Physical Chemistry, November.* 'History of the Water Problem' (Mrs. Fulhame's theory of catalysis), by J. W. Mellor. A sketch of Mrs. Fulhame's 'Essay on Combustion,' published in 1794, in which appears the first clear statement of the influence of water on chemical transformations. 'An Apparatus for the Electrolytic Determination of Metals, Using a Rotating Cathode,' by E. S. Shepherd. By this means the copper in chalcopyrite was determined electrolytically in from twenty-five to forty minutes. 'Solubility of Calcium Sulfate in Aqueous Solutions of Sulfuric Acid,' by F. K. Cameron and J. F. Breazeale; 'The Solubility of Magnesium Carbonate in Aqueous Solutions of Certain Electrolytes,' by F. K. Cameron and A. Seidell. *December.* 'Action of Sodium and Potassium Amalgams on Various Aqueous Solutions,' by Gustave Fernekes; 'The Rate of Formation of Iodates in Alkaline Solutions of Iodin,' by E. L. C. Forster; 'Iron Salts in Voltameter Solutions,' by J. M. Bell.

## SOCIETIES AND ACADEMIES.

### THE WASHINGTON ACADEMY OF SCIENCES.

THE annual meeting of the Washington Academy of Sciences was held on Wednesday evening at the Cosmos Club and the following officers were elected for the ensuing year:

*President*—Charles D. Walcott.

*Vice-Presidents*—From the Anthropological Society, D. S. Lamb; Archeological Society, J. W. Foster; Biological Society, B. W. Evermann; Botanical Society, F. V. Coville; Chemical Society, F. W. Clarke; Entomological Society, W. H. Ashmead; Geographic Society, A. Graham Bell; Geological Society, G. K. Gilbert; Historical Society, W J McGee; Medical Society, C. W. Richardson; Philosophical Society, C. F. Marvin.

*Secretary*—Frank Baker.

*Treasurer*—Bernard R. Green.

*Managers:* 1905—L. O. Howard, O. H. Tittmann, Carroll D. Wright; 1906—C. W. Hayes, G. W. Littlehales, C. Hart Merriam; 1907—Geo. M. Kober, Gifford Pinchot, F. A. Lucas.

### PHILOSOPHICAL SOCIETY OF WASHINGTON.

AT the 33d annual meeting, December 19, 1903, Professor C. F. Marvin, of the Weather Bureau, was elected president; Messrs. Abbe, Hagen, Littlehales and Day, vice-presidents; Mr. B. R. Green, treasurer; Messrs. Hayford and Wead, secretaries, and Messrs. De Caindry, Paul, Winston, Bauer, Briggs, Fischer, Harris, Rosa and Abbot as members of the general committee; on this committee are also *ex officio* Past Presidents Dall, Walcott, Rathbun and Gore.

The secretaries' and treasurer's reports showed the society to be in a prosperous condition.

THE 577th regular meeting was held January 2, 1904, President Marvin in the chair.

Mr. F. G. Nutting presented by invitation a paper on 'The Electron Theory of the Radiation of Gases,' pointing out how this theory explains various peculiarities in the spectra of gases.

Mr. C. G. Abbot then described work of the past two years at the Smithsonian Astrophys-

ical Observatory, consisting in measures of the transparency of the air, the rate of receipt of solar energy at the earth's surface, and computations therefrom of the 'solar constant' of radiation and of the probable temperature of the sun.

The transparency of the air, measured at many different wave-lengths by the aid of the spectro-bolometer, had appeared to vary greatly, so that the means for the first eight months of 1903 fell below the means for 1901–2 by amounts ranging from five per cent. in the infra-red, to twenty per cent. in the blue. During the latter four months of 1903 the transparency had again risen, and approached within two or three per cent. of its values for the year before.

Results were given of some twenty separate determinations of the solar constant, but these depended directly on the constants and theory of the mercury pyrheliometer, so that they may later be subject to amendment. In response to questions Mr. Abbot described a new form of pyrheliometer capable of exact checks on its results, and now being tried with most promising results at the Astrophysical Observatory.

A curve was shown giving the mean of five days' determinations of the distribution of solar radiation outside the atmosphere. From this the position of maximum radiation appeared at a wave-length of $0.49\mu$, corresponding, according to Wien's law, to a solar temperature of from 5800° to 5900°.

Dr. Day remarked that the mean value of the solar constant, as given by Mr. Abbot—2.167 calories per cm.$^2$ per minute—would yield by Stefan's law a solar temperature of 5700° to 5800°.

CHARLES K. WEAD,
*Secretary.*

NEW YORK ACADEMY OF SCIENCES.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

THE regular meeting of the section was held on January 4 at the American Museum of Natural History. The officers of the section for the year 1904, who were elected at the last regular meeting of the section, are:

*Chairman*—Professor Charles Lane Poor.
*Secretary*—Mr. Charles C. Trowbridge.

The first paper of the evening was read by Professor Herschel C. Parker and was entitled 'Altitude Observations with the Hypsometer in the Canadian Rockies.'

A brief outline of the various methods used in altitude determinations was first presented, showing that all are based on two general methods, triangulation or measurement of atmospheric pressure. In the latter method the determinations are made either by means of the several forms of barometer or by the hypsometer. The difficulties attending the use of all of the different forms of barometer were pointed out and the advantages of portability and accuracy of the hypsometer shown. Examples were then given illustrating the extremely satisfactory results obtained with the hypsometer during mountaineering expeditions in the Canadian Rockies last summer.

Professor Parker has had many years' experience in mountain work, making numerous 'first ascents' in British Columbia and Alberta, and he gave as his conclusion that the hypsometer is by far the most convenient and accurate instrument for the determination of altitudes under ordinary mountaineering conditions.

The second paper was read by Dr. George F. Kunz and Professor Charles Baskerville on 'Phosphorescence in Diamonds Produced by Pitchblende.' They stated that a naturally fractured piece of pitchblende (uraninite), weighing 800 grams, from Pribram, Bohemia, caused the $14\frac{1}{32}$ carat diamond (tiffanyite) * to phosphoresce when laid upon it, or even when a piece of window glass or a board three fourths of an inch thick was interposed. The diamond glowed, although more than one inch of space intervened between it and the pitchblende. We have in this instance a substance with a radio-activity of only 2 or $2\frac{1}{2}$ affecting a radio-actively responsive substance, proving that there exists a body of the latter character in this case that responds almost to the unit one of radio-activity. The same specimen of pitchblende did not affect a platinum-barium cyanide screen. Another specimen of pitchblende from Pribram, and others from

* SCIENCE, December 18, 1903.

Johanngeorgenstadt, Saxony, and Central City, Colorado, caused the diamond to phosphoresce. It was further shown that if either kunzite (a variety of spodumene), pectolite or wollastonite, pulverized, were mixed with radium-barium carbonate, of 240 activity, the mixed powder became permanently luminous. When these mixtures were put in a Bologna flask and held on a metal plate, hot but not showing any color, they immediately became very luminous and remained so for a long time. Kunzite, pectolite and wollastonite became phosphorescent by heating alone, the kunzite showing an orange glow. When a kunzite crystal 5 cm. square and 5 cm. thick was exposed to the passage of an oscillating current, the entire crystal glowed an orange pink, losing its lilac color, a well-defined line through the center in the path of the current being much more brilliant; this phosphorescence lasted for quite a time after exposure. Further experiments were made with the same sensitive diamond mentioned above as to its tribo-luminescence. Prints were obtained from negatives made by laying the diamond face downward directly upon the photographic plate, and rubbing the back of the diamond with a stick coated with wool, in one instance for a quarter of a minute, in another for one half minute, the tribo-luminescence induced causing the printing. The same type of diamond from British Guiana, when heated on a metal plate below redness, phosphoresced distinctly, as also did pectolite and wollastonite. We have here, therefore, luminescence of the tiffanyite body in diamond, produced by radio-active pitchblende, by friction and by heat.

The next paper on the program was the first of a series of papers on 'Recent Progress in Physical Science,' and was delivered by Dr. Bergen Davis, who spoke on 'The Latest Theories Relating to the Discharge of Electricity in High Vacua, and Ionization of Gases.' Account was given of Dr. H. A. Wilson's investigation of the distribution of electrical intensity along the striated positive column, and his theory for the electrical intensity in a uniform positive column. An outline was also given of Professor J. J. Thompson's theory of the discharge through Geissler tubes. Dr. Davis also reviewed Professor J. S. Townsend's theory of the sparking potential, Professor Townsend having showed that the ionization is due to impact of both positive and negative ions with the neutral molecule. The theoretical sparking potential thus deduced agrees very closely with the experimental value.

Charles C. Trowbridge,
*Secretary.*

THE AMERICAN CHEMICAL SOCIETY.
NEW YORK SECTION.

At the meeting held on January 8 at the Chemists' Club, 108 West 55th Street, the program was as follows:

*The Dietetic Value of Patent Foods:* W. D. Halliburton.

Professor Halliburton, who was present as the guest of the section, spoke especially of the conditions influencing the digestibility of various foods and dietetic preparations, the relative importance of nitrogenous and non-nitrogenous nutrients, the disadvantages of separating a single nutrient from the other constituents of the food in which it occurs, and the question of the nutritive values of meat extracts and proteolytic products. It was pointed out that while the meat extracts are practically devoid of food value, the preparations which consist of proteolytic products, such as proteoses and peptones, have practically the same nutritive effect, 'nitrogen for nitrogen,' as the original proteids, being synthesized to proteids in the body, probably in the epithelial cells. In conclusion Professor Halliburton urged the cooperation of chemists with physiologists and physicians in the education of the public, and the prevention of fraud in the matter of artificially prepared and 'patent' foods.

*Notes on the Preparation of Standard Alkalimetric Solutions:* F. D. Dodge.

Dr. Dodge reviewed the principal methods employed and discussed especially the merits of various acid and alkaline substances which have been suggested as standards for use in the direct methods of standardizing. For this purpose he proposes the use of salicylic acid

for titration in alcoholic solutions, and of the acid phthalates where aqueous solutions are to be used. In the discussion following the reading of this paper, Professor Coblentz spoke highly of tartaric acid and acid potassium tartrate as standards for titration in aqueous solutions.

*On the Structure of Metals and Alloys; Aluminium Alloys:* William Campbell.

Dr. Campbell, after describing the microstructure of the whole series of alloys of copper and aluminium, and the change in structure due to casting, dwelt at some length on the change which takes place in the solid state in alloys containing over 84 per cent. copper. It appears that the alloys solidify as solid solutions, and at a lower temperature rearrange themselves in a manner similar to that of the alloys of copper and tin between 68 and 75 per cent. copper, or of the carbon-iron alloys containing up to 1.8 per cent. carbon. Photographs of the alloys which had cooled slowly were contrasted with those of alloys which had been quenched from above the critical temperatures. On annealing the quenched specimens, the original structure was restored. The paper was illustrated by lantern slides.

*The Determination of Molybdenum in Steel:* F. V. D. Cruser.

Mr. Cruser described the analytical separation of molybdenum from iron and the rarer metals now added in making steel, such as chromium, tungsten, uranium and vanadium, and the various methods used for the determination of molybdenum. In the course of the work it was found that the separation of iron from molybdenum by caustic alkali was inaccurate, due to the formation of small but variable quantities of ferric molybdate which was soluble in alkali. A method was worked out which is believed to be entirely accurate; it is in brief as follows: Dissolve the steel in nitrosulphuric acid; separate the molybdenum as $MoS_3$ by hydrogen sulphide under pressure; dissolve the sulphide and convert to sulphate; reduce the molybdenum by zinc and reoxidize by a standard solution of permanganate. If tungsten is present the addition of three to four grams of tartaric acid prevents its contaminating the molybdenum sulphide. This method was tested on a number of steels and molybdenum alloys, and none of the metals present was found to interfere, while by the methods recently published the results were unreliable in many cases, especially when tungsten or vanadium was present.

*On the Determination of Nitrogen in Food Materials and Physiological Products:* H. C. Sherman. Read by title.

H. C. Sherman,
*Secretary.*

## DISCUSSION AND CORRESPONDENCE.

### CONVOCATION WEEK.

The multiplication of scientific and learned societies is the normal outcome of the enormous expansion in the fields of learning during the past few decades. The farther one pursues a single branch, say of science, the more he becomes separated from those following other branches of science. The scientific society represents, like all other societies, the grouping of those of similar tastes for mutual profit and entertainment. As soon as a society covers a field so large that many of the matters brought before it are uninteresting or unprofitable to any considerable number, the society breaks up, either into new societies or into sections, each with its own gatherings. This fact was recognized early in the history of the American Association.

But specialization can be carried too far. I do not mean merely that the man, mining so industriously at the bottom of his own shaft, is of little account to the rest of the world, indeed, often forgets that there is any world outside of his own hole. He himself may recognize that this is true and not care a whit, so that he discovers the truth for which he is searching. What is of far more importance is that in losing his sense of perspective he greatly hampers his own work. He needs to know what others are doing that he may gain a better conception of what he himself is doing.

We need the meetings of the special societies, and we need also the meetings of a general society, where men come in contact with

the workers in other fields than their own. The value of such gatherings is not so much in listening to papers or addresses, though these are often profitable, but in social intercourse, coming into contact with minds not cast in our own mold. It is particularly stimulating to younger men thus to meet with those who have already won their spurs, and is it not the duty as well as privilege of the latter to give this inspiration to their younger colleagues? The discovery of a man may be as important as the discovery of a theory.

How then shall such an ideal be brought to pass? We have such a society, covering the general field of science, the American Association; what should be its function and what the character of its meetings?

1. In its journal, for such we may call Science, it is actually accomplishing much to prevent narrowness in specialization. In an hour each week I get a glimpse of what is going on in the world of science. It seems to me that no specialist can afford not to at least glance through the carefully prepared papers on special branches, yet of general interest, the discussions and correspondence, the reviews of literature, the current notes on special sciences (would there were more of them!) and the general notes and news.

2. As regards meetings. Each society should have its regular annual meeting in the summer, for the presentation of papers, for excursions, for study or for whatever is of most value to the members as specialists. For many of the societies summer is the most favorable time for such purposes. These meetings should be held by each society without regard to the meetings of any other society, as to either date or place. In winter there should be a convocation week meeting of all the scientific societies, together with the American Association. At this meeting it seems to me that no papers of restricted interest should be read, but rather presidential addresses and lectures should be given, and sectional discussions (carefully prepared by a limited number of leaders) on topics of general sectional interest. No inconsiderable attention should be devoted to the social side of these annual meetings, but the time should be so apportioned daily that there should be no conflict; that is, a certain portion of each day should be set apart for each general purpose.

All this would necessitate points of adjustment between the sections of the American Association and the various societies. The functions of the sections and the societies are in many respects similar, and the question may well be asked, as it has been many times in the past, as to whether there is a place for both. Would it not be better for the association to become merely a federation of the scientific societies of the country? As it is at present, many members of the different societies attend the meetings and enjoy all the privileges of the association, except holding office and receiving the *Proceedings* of the association and Science, and contribute nothing to the treasury. Then there is always more or less friction in arranging the sectional programs where there is this dual control. In case of federation, with the council made up, perhaps exclusively, of representatives chosen by the societies, all this would be obviated. The chief difficulty would probably be arranging for the financial support of the federated association. Yet this would be by no means insuperable. It could be provided that each member of the societies should be charged the present dues of three dollars for the support of the federation, receiving therefor Science as now. Since the addresses would be printed in Science, the *Proceedings* could be discontinued, and a collective list of members printed in addition to the lists of members of each society now published. The reduced expense would in the end probably amount to as much as the income received from initiation fees, a source of income dependent upon growth in the association. Of course, such a plan would necessitate a certain amount of altruism on the part of the federated societies, but I can well believe a majority of the members of every society would be willing to sacrifice something for the general good of science, even outside of their own specialties.

Such a winter gathering should be held in a large and easily accessible center, in order to insure the largest possible attendance. Here

we meet the difficulty of the great distances separating workers in the various sections of this country. A satisfactory way of obviating this would be to hold a general meeting of the association only biennially, dividing the association geographically in the alternate years, with meetings simultaneously in perhaps half a dozen sections of the country.

Such changes as these suggested are radical, but changes have been going on in the administration of the association for the past decade, and it is evident other changes must come. Would not these meet the requirements?

Jas. Lewis Howe.
Washington and Lee University.

To the Editor of Science: The relation which the various scientific societies of the country bear to the American Association is one which demands careful consideration. First of all I think it may be assumed that the organization of all scientific societies should be of such a nature as to promote the welfare of the American Association. The latter body is the one organization of the United States in which all scientific men are brought together on a common level.

The necessity for special societies is, of course, recognized, but the greater necessity for a single society is equally as evident.

I should like to discuss, for a moment, some of the problems suggested in an article in Science, January 8, on convocation week, and especially with reference to the position occupied by the American Chemical Society. This society now has a membership of nearly twenty-five hundred and is rapidly growing. I have consulted the records of the attendance at the meetings of the American Association for the past few years and find that the members of the American Chemical Society represent about 30 per cent. of the whole attendance. During the whole of this period the American Chemical Society has held its meetings in conjunction with Section C of the association and the utmost harmony and good-will have prevailed. It appears to me, therefore, that the American Chemical Society has a more intimate union with the American Association for the Advancement of Science than any of the other affiliated societies. My idea is that each section of the association would be benefited by the adoption of this system of cooperation. It might even be made more intimate with great advantage. For instance, in the case of Section C the officers of the American Chemical Society might well be accepted as the officers of Section C, thus making Section C practically the American Chemical Society. It is evident at once that the aims and intentions of Section C and the American Chemical Society are the same, and by having the same set of officers there would be less trouble in arranging the program and dividing the time than there is at present. This, however, is only a suggestion, as I realize that the present form of collaboration is very satisfactory.

If all the other branches of science could be represented by powerful national societies the same collaboration could be established in almost all the sections. For instance, there is no reason why there should not be an American Botanical Society of approximately the same numerical strength as the American Chemical Society, and this is true of physics, geology, entomology and the other sciences. It might be well, however, to establish a limit of membership, so that before a subsociety should become intimately associated with the parent society it should have a membership entitling it to such a position. I should say that any national society representing a great science which has a thousand members could safely be admitted to the same affiliation as the Chemical Society now enjoys.

Unfortunately, I think, for the advancement of science, there is too great a tendency to organize separate and independent societies in each branch of investigation. This has been done already in regard to chemistry in this country in the establishment of two very powerful societies entirely distinct from and without any affiliation whatever with the American Chemical Society. I refer to the American Electro-chemical Society and the American section of the Society of Chemical Industry. I do not wish to speak in a reproachful way of these two organizations, because I am a member of both and fully appreciate the great work that each is doing, but it

seems to me that this work might be even more effective if conducted in conjunction with the American Chemical Society.

The same tendency to disintegrate seems to pervade the other sciences. For instance, I note that at the St. Louis meeting there were represented in the American Association the American Society of Naturalists and the American Society of Zoologists. Now, of course, I do not know just what kind of a science naturalism is, but I suppose a part of its work is zoology. I also notice that there were represented the Association of Economic Entomologists and the Entomological Club of the Association, the Association of Plant Breeders, the Botanical Club of the Association, the Botanical Society of America, the Central Botanists' Association, the Wild Flower Preservation Society of America and the Fern Chapter. Again I am at a loss to know exactly what a fern chapter is, but I assume that it has something to do with botany. I also note the presence of some societies which can hardly be associated with any one science, for instance, the 'Sigma Xi Honorary Scientific Society,' the Society for Horticultural Science and the Society for the Promotion of Agricultural Science. Would it not be better for all parties concerned if all these botanical clubs and societies were sections of one great national society? It seems to me, therefore, that the sections of the association devoted to physics could thus become affiliated or become really the American Physical Society, the geological bodies become the American Geological Society, zoologists become the American Zoological Society, the entomologists the American Entomological Society, and all the botanical clubs be united in the American Botanical Society. The presidents of these societies, respectively, would become the presidents of the sections of the association. This would in no way interfere with the autonomy of the national scientific societies, but would unite them all under a common head, namely, the American Association for the Advancement of Science. It would also permit the great national societies to divide up into sections to study special subjects. Separate sections of the American Association could be formed for scientific discussion of general subjects such as economics, medicine, etc. It would, indeed, be excellent if the American Medical Society would become affiliated in a similar way with the association. If all this could be accomplished, instead of having four thousand members of the American Association, we would have four times that number. The moral effect of such a union would be great and its economical effect still greater.

There may be many objections to such a form of affiliation, but judging from experience in connection with the American Chemical Society and its relation to the American Association, I should say that these objections are not fatal.

H. W. WILEY.

TO THE EDITOR OF SCIENCE: A response to your inquiry, if a faithful reflection of my convictions, may serve only to range me with a conservative minority on this matter of scientific organization and expose me to the raking fire of the progressists.

I confess to a feeling of apprehension at the insistent and impetuous efforts which are making toward the centralization of scientific endeavor in the United States and the creation of a formidable scientific machine in which individuality is to be reduced to a cog. Scientific organization on a grand scale is claimed in your recent vigorous brief on its behalf, to be important, not for the good of the scientific man, but for that of science, in which particular the science union or science syndicate will differ from the actual genius in the combinations of labor or capital. These are organized emphatically for the benefit of the individuals who are in, not for any such vague objective as the good of labor or the idealizing of business. The ideal man of science may be so supramundane that he can afford to give allegiance to such an altruistic purpose as the enthronement of science regardless of his own interests, but the actual scientific investigator, no whit below the ideal in his ardor, wants to do the work, as much of it as his powers and his years permit, to achieve all within the range of his opportunities; and he also has a just pride in and right

to the honors that he earns and the credit that he wins. If he is laureled by some exclusive society of select spirits wherein the seating capacity is small, some ancient, time-honored fraternity whose notice is recognition of his successful achievement, let him wear his honors. They are well won and were well worth striving for, unless the world is to be made over. But laurels on the wheels of a great machine will be very much in the way.

This central agent of science will, you venture to hope, obliterate all individual rivalry for precedence, all controversy directed to enforce or maintain the individual view or interpretation, and differences of opinion are, I infer, to be adjusted by conference and arbitration; but I hold it the very essence of scientific vigor that the investigator maintain his conclusions against all comers. In keen, well-behaved controversy, more than in conference, in determined and relentless adherence to conviction, rather than in meek surrender to 'the good of the party,' the real vitality of scientific labor reveals itself. If any laborer in your own field of research is weak, faulty in his method, careless of fact and indifferent in deduction, it is somebody's duty to tell him so or the truth may remain concealed, and, I take it, it is the truth we are after and not merely the 'advancement of science.' But a science machine that will do away with all this, throws laurels in the waste basket and calls every one mister, stops the mouths of lions, pools all individuality and makes us all sucking doves and a spectacle for angels, may seem a beneficent institution, for now that all American men of science have been reduced to mere algebraic expressions, tagged and filed, there would be nothing for them but to take their numbers, get their union cards and try to live up to the motto, 'Better to be the tail of a mouse than the head of a lion.'

After perusing your article with care I am disposed to apprehend that centralization of science means the creation of a juggernaut which will crush endeavor, stupefy ambition, incinerate stimulus, minify personal achievement and cachinnate at honor—the sweet recompense which comes from a life of earnest labor. John M. Clarke.

January 12, 1904.

To the Editor of Science: I thank you for your invitation to join in discussing the question how best to organize into one cooperative fraternity all our national scientific societies.

I would have the members of the council of the American Association feel that the entire burden of this holy mission rests on their shoulders; that as success would be their crown, its failure would be their undoing; if need be the martyr spirit is to be dominant, and whosoever would be chief, let him be the servant of all.

Say to them, always seek to draw and not to drive, to encourage and not to discourage; to suggest cleverly and not seem to direct; to attract and not to coax or bully. The old saying, Where the carcass is there will the eagles be gathered together, will prove true in their case as in every other. Remember what Jean Paul told us long ago, Not all are always reasonable, but all have feeling—never forget that in addressing them.

I would have the council in this matter generous to a fault. A distinguished botanist living 3,000 years ago or such a matter, who knew the plants of his country from the lichens to the conifers, must have been thinking of our association council when he wrote: 'There is that scattereth and yet increaseth and there is that withholdeth more than is meet and it tendeth to poverty.'

Try to improve your volume of *Proceedings*. It is not altogether hopeless, though you shake your heads. Remember Hercules. Moreover, dear friends, the weekly journal chosen to be the Aaron of our scientific Moses ought to be dignified, true to the truth always, but at the same time moderate in utterance. Surely, surely, no council planning to do missionary work can make friends at the outset by denouncing through its official organ three highly honored institutions of science as having completely failed.

'Let dogs delight,' etc.

Take especial pains to have at the annual gatherings and mass meetings men of distinction, of whom all have heard and whom they desire to see. I recall the long-ago delight with which my young eyes first gazed on E. B. Tylor, and when as a student I held in my

grasp the hand of Lewis H. Morgan. If such men only knew how good the sight of them is to young and longing eyes, they would make sacrifices to give so much pleasure.

Encourage specialization. The closest affiliation of specialists and aggregation into a mutually helpful cooperation are necessary to the intension of a science. It can not be too compact or too lively. The moment they organize the institutional mind is born.

But to the special societies let me say that the beau ideal of learning is to know all about some and some about all. In your meetings the infimæ species of details, instruments and processes are scrutinized and discussed; but in your family gatherings all learn the results of the tedious labors of each. You acquire the ability to read or listen intelligently. Let me illustrate great things by small: There is an old man in one of the dependencies of the Smithsonian who was engaged to write up the textile arts of the American aborigines. Through its many agencies he was furnished with overwhelming material from the whole area between Point Barrow and Magellan Strait; between Nova Scotia and Attu Island. If he had possessed seven league boots, a canoe that shot past the wild geese, the hundred eyes of Argus Panoptes, the hands of Briareus and the longevity of Methusaleh it would have surpassed his powers to bring together so much. But no sooner had he sat down among the stuff than he discovered his lack of omniscience, a quality required of him before taking the first step in so comprehensive an industry. He must know chemistry for dyestuffs, geology for horizons, geography and meteorology for environments, botany thoroughly for plants, zoology for staples and implements, ethnology for peoples, philology for names, not to neglect mythology and folklore for the charming symbolism.

I will not worry you with the long list of the Covilles, Merriams, Holmeses, Houghs, Chesnuts, Willoughbys, Boases, Dorseys, Mooneys and more; nor of the many bureaus and branches of the government that gladly put themselves at his disposal; nor of the leading museums, Peabody, American, Field-Columbian, Golden Gate Park, with the rest, whose treasures illustrate his pages. The thing that bothers him now is what name to put on the title page.

The lesson I would learn from this parable is that the highest possible specialization only makes the closest solidarity that much more necessary. The council has my blessing and best wishes and shall have my cooperation in its endeavor.

O. T. Mason.

January 19, 1904.

### SOIL WORK IN THE UNITED STATES.

In the *Beet Sugar Gazette,* published on December 5, 1903, on page 419 is given an account of the trip of the Secretary of Agriculture through the beet sugar region of Michigan. At Rochester the Secretary made an address in which are found the following words:

"When I went to Washington I found that we had no knowledge of the soils and I went to work and organized a bureau of soils and have over two hundred scientists engaged in this work. I shall send a corps of soil physicists next year to every sugar factory in Michigan to examine the soils, and the information which the Department of Agriculture obtains is at your disposal."

In many other public addresses the Secretary of Agriculture has given expression to similar sentiments, and especially has he criticized the colleges and universities of the United States, because, as alleged, they fail to train their students in such a way as to make them valuable to the Department of Agriculture.

We all know that the Secretary of Agriculture means well and does the best he can for the interests over which he presides. Under his energetic administration, the activity of the Department of Agriculture has been materially increased, and its usefulness greatly enhanced. He does not pretend to be a scientific expert, and we must presume that his ideas on scientific work are mainly the result of the environment in which he lives. It, therefore, becomes an interesting question whence has come to him the information that the agricultural colleges fail to train students usefully in agriculture; that the uni-

versities are doing nothing for the promotion of agricultural science; and that at the time he came to Washington, and until the Bureau of Soils was established, nothing was known about soils—meaning, presumably, the soils of the United States.

In the light afforded by Bulletin No. 22 of the Bureau of Soils, which I have recently discussed in the columns of SCIENCE, the source of the Secretary's information is not far to seek. Having departed from all precedent in the matter of soil work, whether in the field or in the laboratory, in the old world or in the new, the Bureau of Soils simply declares all former soil work to be '*nul et non avenu*'—void and of no effect; and so informs the Secretary.

In view of the existing records, this seems an extreme liberty to take with the facts of the case. It is true that in some of the states, the public surveys and even some stations have taken the soil features but very little into account. But in many others, the soil features have been quite elaborately observed, elaborated and discussed. Beginning more than half a century ago, David Dale Owen conducted the work of the geological surveys of Kentucky and Arkansas; and we find in the reports of these surveys not only the chemical analyses of several hundred soils from these two states, but, accompanying them, descriptions of their physical and agricultural characters, as well as of their native vegetation. Following the lead of Owen, the present writer undertook similar work in connection with the geological and agricultural survey of Mississippi, and from 1857 to 1873 continued these studies from the physical, chemical and botanical standpoint. In 1880, being in charge of the report on cotton production of the Tenth Census of the United States, he undertook to compile detailed agricultural descriptions of the cotton-producing states (then including California), which were elaborated largely by the respective state geologists, and form parts of Vols. V. and VI. of the Census report of 1880. There are embraced within these volumes extended descriptions and maps of the several soil areas in these states, with 612 chemical and 12 physical analyses of soils, fully discussed in their bearings on agriculture. In 1892, the Department of Agriculture published, as Bulletin No. 3 of the Weather Bureau, a paper prepared by myself 'On the Relations of Soils to Climate,' in which among other things there is given a discussion of 779 analyses of soils of the United States, and of the nature, occurrence and reclamation of alkali lands.

Since that time many other states have entered upon similar lines of work; among them especially Minnesota, Texas, South Carolina, North Dakota, Washington, Idaho, Wyoming, Michigan and Rhode Island, in some cases with very elaborate cultural data and discussion. The entire number of soil analyses made in the United States thus far is probably in excess of 1,500.

In the face of all these facts, of which the records are easily accessible, especially at Washington, the Secretary of Agriculture has evidently been informed that practically no soil work worthy of the name had been done in this country until the present Bureau of Soils was organized by him; and has thus been induced to think it a matter of first necessity to send over two hundred scientists (*sic*) into the various states to fill these glaring deficiencies. Evidently it *has* been possible for the Bureau of Soils to find within the United States so large a body of qualified soil experts. The phenomenal rapidity with which these observers map the soil areas laid down in the reports of the bureau, seems to show that this feat has been accomplished. How well the work so done will stand the test of criticism from the scientific and practical standpoint remains to be seen. E. W. HILGARD.

UNIVERSITY OF CALIFORNIA,
January 8, 1904.

## SPECIAL ARTICLES.

### PRELIMINARY REPORT ON THE CLASSIFICATION OF THE ROCKS OF THE WATKINS GLEN (30′) QUADRANGLE (U. S. GEOLOGICAL SURVEY).*

DURING the summer of 1903 Henry S. Williams assisted by Edward M. Kindle made the

* By permission of the Director of the U. S. Geological Survey.

survey of the Watkins Glen quadrangle preparatory to forming the folio map of this region. The results of the field work are now sufficiently well elaborated to permit of the following announcement:

The general similarity of the rocks of this whole region has made the use of paleontology in classifying them a necessity, and the resulting classification is primarily based upon paleontological evidence.

The rocks of the region have a general southerly dip, and the formations exposed on the surface are all Devonian. The lowest formation mapped is the Genesee black shale outcropping in the extreme northern part of the quadrangle in the bottom of the valleys of Cayuga and Seneca Lakes. Two major formational divisional planes are traceable across the quadrangle from east to west. These planes separate the Genesee from the following Portage, and the Portage from the succeeding Chemung. The paleontology is the chief ground for drawing these lines, but the lithology is in harmony with the other evidence. The Portage formation lying between these two planes attains a thickness of from 1,250 to 1,300 feet. Below it the Genesee is 120 to 150 feet thick. Above the Portage 1,225 feet of Chemung has been traced, but the top of the range of the Chemung fauna was not reached in the area surveyed.

No other planes offered sufficient continuity of evidence, either lithological or paleontological, for drawing the lines across the whole quadrangle. In the eastern half of the quadrangle the Portage is divisible, on clear paleontological evidence, into three members: the lower Portage, approximately 250 feet; the Ithaca, 400 feet; and the upper Portage, 600 feet thick. Faunally the same species characterize the lower and upper members of the Portage. The central member (the Ithaca) holds an entirely distinct fauna, homeotopic with that of the Hamilton and Chemung faunas lying below and above it. The lithological characters of the Ithaca are in general distinct from those of the Portage, but the difference is due rather to the dominance of the argillaceous shales in the Ithaca, over the flags and thin-bedded fissile, and generally dark-colored, shales which are more characteristic of the Portage, than to any uniform lithological character of either.

In the Seneca Lake valley the subdivision of the Portage into three members can not be made out sharply upon either lithologic or paleontologic evidence. A few scattered species of the Ithaca fauna appear within their proper zone, but the lower and upper Portage conditions dominate all through the sections for the whole 1,200 to 1,300 feet. The Portage fauna also recurs in some sections after the entrance of the Chemung fauna into the general region. The faunas of the Genesee and Portage are more closely related to each other biologically than either of them is to the Hamilton or to the Chemung fauna.

A recurrence of Hamilton species takes place in several zones; the more conspicuous cases are near the base of the Ithaca member, in Cascadilla Creek in Ithaca (as was stated in Bulletin 3 of the U. S. Geological Survey in 1884); near the base of the Chemung within the lowermost 100 feet of several sections in the quadrangle; and again in the upper Chemung about 600 feet above its base. This highest discovered *Tropidoleptus* zone is seen in quite a number of the sections in the southern half of the quadrangle.

In these recurrent faunas the more characteristic as well as dominant species are *Tropidoleptus carinatus, Rhipidomella vanuxemi, Cypricardella bellistriata;* also *Phacops rana* has been seen, and specimens of a *Spirifer* not to be distinguished from typical Hamilton forms of *Spirifer* (*mucronatus*) *pennatus.*

The lower zone of this fauna in the Chemung is below the first appearance of *Spirifer disjunctus,* but the upper zone is hundreds of feet above the first appearance of the typical *Spirifer disjunctus* fauna, and in several sections that fauna occurs abundantly both below and above it within a few feet of thickness of strata. The recurrent species are generally associated with a few of the common species of the normal fauna of the part of section in which they occur, but *Spirifer disjunctus* has not been discovered associated with them, though often occurring below as well as above, not very far distant.

These Hamilton recurrent zones rarely occupy over a couple of feet thickness. They are more conspicuous in the eastern than in the western parts of the quadrangle. In them the Hamilton species are often quite abundant, to the almost total exclusion of other species. Some slabs were obtained from actual outcrops on which nothing distinctively Chemung was apparent.

Near the top of the Chemung formation of the quadrangle, in the townships of the southern part of the Waverly quarter sheet are some distinct conglomerates with a fauna diverse from that of the Chemung which appears above as well as below them stratigraphically. The conglomerates are quite local, as shown by their non-appearance at the same altitude in some hills not far distant from those in which they were seen. In several parts of the quadrangle local limestone bands were seen, reaching a thickness of over a foot in some cases.

On the geological map of the state published by the State Geologist in 1894 a line is drawn between Hamilton and Portage, but as to which side of the Tully or Genesee no indication is given, and in the legend the Portage covers lower Chemung and Ithaca. In the revision of that map published in 1901 the outcrop of the Genesee is indicated, this is followed by the Portage in the western part of this region and over the quadrangle in part. In the eastern part the Ithaca rests upon the Genesee, thus making the Portage and Ithaca to occupy the same stratigraphic interval. Further east, in Chenango County and beyond, the lower half of this interval is indicated as Ithaca, and the upper half as Oneonta.

The upper line is drawn in the 1894 map between the Portage and Chemung; in the 1901 map between Portage and Chemung for the western half of the Watkins Glen quadrangle, and for the eastern half between the Ithaca and Chemung.

The result of the summer's work clears up both of these lines, showing the Ithaca to be a member of the Portage formation, as was first pointed out in Bulletin 3 of the U. S. Geological Survey in 1884, where also it was then indicated that the Ithaca is not the lower part of the Chemung (as was claimed by Hall in 1843) but is separated from its base by an upper part of the Portage, of several hundred, now shown to be approximately 600, feet of strata.

H. S. W.

## *CURRENT NOTES ON METEOROLOGY.*

### METEOROLOGICAL SOCIETY OF JAPAN.

Numbers 5 to 8 of the *Journal of the Meteorological Society of Japan*, recently received, show encouraging signs of the continued activity of that scientific body. The society was founded in 1882, and numbers now more than 260 members. The language used in the *Journal* (now in its twenty-second year) has hitherto been exclusively Japanese, but in the future it is intended to insert articles on Japanese meteorology, as well as on other scientific matters, in English, French and German. The *Journal* is published by the editorial committee of the society, with headquarters in the Central Meteorological Observatory in Tokio. The title pages of the separate issues of the *Journal* are printed in English, and the list of papers shows a considerable range of interesting topics, *e. g.*, 'Cloud Cap on Mt. Fuji,' 'On the Stationary Low Pressure Area in Formosa,' 'Storms in the North Pacific Ocean in April, 1903,' etc.

### PROTECTION OF PEACH TREES FROM FROST.

In Bulletin 80 of the Agricultural Experiment Station of the Agricultural College of Colorado (1903) a description is given of the new method of protecting peach trees from frost by 'laying down.' This was first tried in the fall of 1896, at Cañon City, and has proved very successful. Early in November (at Cañon City) the trees are put into winter quarters. The earth is removed from a circle about four feet in diameter around the tree, and water is turned on. When the ground is saturated, the trees are worked back and forth, and are finally pushed over, with comparatively little injury to the roots. Then the limbs are brought together by a cord, and burlap, covered with earth, is put over them. In the spring, the covering is gradually

loosened, and later removed; then the trees are raised and propped up.

THE METEOROLOGY OF THE SÄNTIS.

Hann continues his valuable studies of mountain meteorology in a publication entitled 'Die Luftströmungen auf dem Gipfel des Säntis und ihre jährliche Periode' (*Sitzungsber. Wien Akad. Wiss., math. naturwiss. Kl.*, CXII., Abth. IIa, 1903, pp. 42), the Säntis being one of the most important mountain observatories of Europe. Fifteen years (1886–1900) of hourly observations of wind are discussed in detail, and compared with similar records at lower levels. In winter the mean wind direction is northeast; in summer nearly due west; in autumn (September-November) south to southeast. Southwest is the most frequent wind direction.

SOUTH AFRICAN METEOROLOGY.

South African meteorology is beginning to make encouraging progress. Three recent papers, by J. R. Sutton, have been published in the *Transactions of the South African Philosophical Society,* Vol. XI., Part 4, and Vol. XIV., Parts 1 and 2, under the titles 'Some Pressure and Temperature Results for the Great Plateau of South Africa,' 'Results of some Experiments upon the Rate of Evaporation' (at Kimberley) and 'An Elementary Synopsis of the Diurnal Meteorological Conditions at Kimberley.' Mr. Sutton, who is already known for previous meteorological work at Kimberley, is in charge of the meteorological station of the De Beers Consolidated Mines.

R. DeC. Ward.

## *THE MISSOURI BOTANICAL GARDEN.*

Advance proofs of the fifteenth administrative reports on this institution, which have been received from its director, show customary growth and activity. In 1903 $27,272.48 was expended in maintaining the garden itself; $3,085.69 was spent on the herbarium; $4,239.85, on the library; $5,325.98, on the office; $967.68, on research; and $1,307.87 for the training and care of garden pupils. For improvements of the grounds and buildings $1,954.35 was spent; a fire-loss to the plant houses and collections led to the expenditure of $2,033.40; $481.17 was spent on the preparation and equipment of a phyto-chemical laboratory, and the cost of publications was $1,849.16.

The director's report combines a summary of progress for the past five years with the details for 1903, and the liberal use of coordinate curves makes the growth in all departments evident at a glance. An inventory at the end of the year showed that 11,357 distinct species or varieties were then in cultivation, an increase of 41.8 per cent. for the last five years. The visitors for the year numbered 79,039, and their distribution by months forms an interesting curve of seasonal out-of-door life in St. Louis. The herbarium now contains 465,205 specimens, valued at $69,780.75. Of these, 37,408 were incorporated last year, and the growth for the last five years amounts to 51.3 per cent. of the number reported at the end of 1898. The library contains 42,262 books and pamphlets in nearly equal numbers and 311,218 index cards, and is valued at $74,472.90. Its growth for the last five years is shown to be 27.7 per cent. The serial publications now received number 1,185, an increase of 27.4 per cent. over the number received five years ago.

The continued use of the equipment of the garden for research by its employees is noted, and the statement is made that "in every feasible way the library, herbarium and living collections are made useful to investigators, whether connected with the institution or not: when they can be used on the spot, every possible facility for their use is given visiting botanists: when this is not possible they are sent to trustworthy persons or institutions, when their safe return is guaranteed; and, except for specimens or books of especial value which could not be replaced in case of loss, or those in constant use, the garden has always stood ready to place its library and collections for a reasonable time at the disposal of botanical departments of colleges, or of capable investigators not having official connection with the centers of learning."

Small but satisfactory results are reported in the Shaw School of Botany, through which

in 1903 two candidates earned the master's degree, and one, the doctor's degree, in Washington University, in which one candidate for the former and three for the latter are now enrolled with majors in botany.

Details are given of the workings of the school of gardening, the organization of the office staff, and the gardening operations for the past year; and the report closes with an account of the special testamentary provisions of the founder of the garden, among them the recent banquet of the trustees, at which several hundred of the scientific men of the country were guests during the last convocation week.

## *THE DEPARTMENT OF ECONOMICS AND SOCIOLOGY OF THE CARNEGIE INSTITUTION.**

The Department of Economics and Sociology of the Carnegie Institution was by the action of the executive committee placed wholly in charge of Carroll D. Wright, commissioner of labor. The first great work to which this department is to address itself is the preparation of an economic history of the United States, embracing eleven subjects:

(1) *Population and Immigration.*—To this branch Commissioner Wright has assigned Professor Walter Willcox, of Cornell University. Professor Willcox will not treat his subject merely on its statistical side, but will deal broadly with such questions as the influence of the movement of population and immigration on the economic development of the country, one of the principal features to be considered being the routes that immigration has taken at various stages.

(2) *Agriculture and Forestry,* including public land and irrigation interests. To this work Mr. Wright has assigned President Kenyon L. Butterfield, of the Rhode Island Mechanical and Agricultural College.

(3) *Mining.*—This is committed to Edward W. Parker, of the Geological Survey.

(4) *Manufactures.*—This subject will be handled by S. N. D. North, director of the United States Census.

* From the New York *Evening Post.*

(5) *Transportation* will be considered by Dr. W. Z. Ripley, of Harvard University.

(6) *Domestic and Foreign Commerce,* including fisheries, is in the hands of Professor Emory R. Johnson, of Pennsylvania University.

(7) *Money and Banking* will be considered by Dr. David R. Dewey, of the Massachusetts Institute of Technology.

(8) *The Labor Movement* has been reserved by Commissioner Wright for himself.

(9) *Industrial Organization* is the subject assigned to Professor J. W. Jenks, of Cornell University.

(10) *Social Legislation* will be treated by Professor Henry W. Farnam, of Yale University. He will include in his study provident institutions, poor laws, and kindred topics.

(11) *Federal and State Finance,* including taxation. The authorship of this treatise the department is not yet ready to announce.

The collaborators will utilize all available material that has been published mostly in fragmentary ways, as well as all material that can be secured from original sources by special research. For this purpose, graduate students and others interested in special lines will be employed. It is impossible to state how long it will take to finish the work, but it will be pushed with all the force compatible with accuracy and completeness. The allotment of money for the first year is $30,000.

As has been said, Commissioner Wright has been put in charge of the entire enterprise, and during the present year he will have the direction of the work of the staff from the office of his department at Washington. After this year, when he will have retired from the Department of Labor, he will direct the work from his new seat of activity in Worcester, Mass.

## *SCIENTIFIC NOTES AND NEWS.*

The twenty-fifth anniversary of the conferring of the doctorate on Dr. Wilhelm Ostwald was celebrated at Leipzig on December 19. A *Festschrift* has been prepared by his pupils.

Professor F. W. Putnam has resigned his position in the American Museum of Natural History which he has held for nearly ten

years. He has been granted leave of absence from Harvard University for three months this winter, and will spend this time in directing the work of the Department of Anthropology and the Anthropological Museum of the University of California. Professor Putnam has been appointed chairman of the Department of Anthropology in the International Congress of Arts and Science at the St. Louis Exposition.

PROFESSOR S. P. LANGLEY has been appointed by the International Meteorological Committee a member of the commission (mentioned on page 658 of Vol. XVIII.) to consider the study of the relations of solar physics to meteorology.

THE board of visitors to the Naval Academy includes President Henry S. Pritchett, of the Massachusetts Institute of Technology, and Professor Ira N. Hollis, of Harvard University.

PROFESSOR F. E. LLOYD, of Teachers College, Columbia University, has received a grant from the Botanical Society of America, to carry on researches at the Desert Botanical Laboratory of the Carnegie Institution at Tucson, Arizona.

DR. NICHOLAS SENN sailed from San Francisco on January 7 for Tahiti, where he will join a commission appointed by the French government to investigate the diseases of the island.

DRS. E. L. TYSER and W. R. Brinckerhoff, of the Harvard Medical School, have been sent on a commission to the Philippines to study smallpox and other contagious diseases.

MR. WILLIAM BARNUM, formerly of the Fish Commission, has been appointed chief clerk of the Carnegie Institution.

PROFESSOR F. H. KING, of the Bureau of Soils, U. S. Department of Agriculture, has resigned. He has been connected with the Bureau of Soils since November, 1901, in charge of the work in soil management.

MR. CHARLES HENRY THOMPSON, assistant in botany at Stanford University, has been appointed to take charge of the Department of Succulent Plants at the Missouri Botanical Garden.

DR. WILLIAM OSLER, professor of medicine at the Johns Hopkins University, will give this year the Ingersoll lecture at Harvard University, his subject being 'Science and Immortality.'

THE chapter of the Sigma Xi at the Ohio State University is giving a series of lectures this winter. The first was by Professor A. D. Cole on 'Why Light is believed to be an Electrical Phenomenon'; the second lecture was delivered January 25 by Dr. Victor C. Vaughan, of the University of Michigan, on 'Immunity from Disease'; the third lecture will be given by Professor F. L. Landacre.

PROFESSOR W. B. SCOTT, Blair professor of paleontology at Princeton University, has begun a course of sixteen lectures at the Wagner Institute, Philadelphia.

THE death is announced of Dr. Georg von reception on January 13 to celebrate the return of some of the members of the *Gauss* South Polar Expedition. Count Posadowsky, minister of the interior, delivered an address of welcome. Dr. von Drygalski then gave a lecture recounting his experiences, and was afterwards presented with a gold medal.

THE prize of the Swedish Medical Association has been awarded to Professor M. G. Blix, of Stockholm, for his work on the temperature of the muscles.

THE death is announced of Dr. Georg von Liebig, docent in climatology at the University of Munich. He was a son of Justus von Liebig.

A CIVIL service examination will be held on March 2 and 3 for the position of miscellaneous computer of the U. S. Naval Observatory.

THE sixth International Congress of Physiology will be held at Brussels from August 30 to September 3. Communications should be addressed to Dr. Slosse, Institute Solvay, Parc Leopold, Brussels, Belgium.

GOVERNOR ODELL has signed a bill authorizing the consolidation of the New York State Medical Society and the New York State Medical Association.

The Madrid correspondent of the London *Times* writes that in anticipation of the total eclipse of the sun of August, 1905, the papers are beginning to urge the government to include in next year's estimates an item providing for a scientific mission of Spanish astronomers to be sent abroad, in order to study in foreign observatories the latest methods of investigating the phenomenon. For the eclipse of 1900 the Cortes voted 190,000 pesetas, but the measure was taken so late that the money was spent at a loss. It may be mentioned that the zone of about 200 kilometers covered by the eclipse of 1905 traverses Spain from Galicia and Asturias to Valencia and Castellon. The northern coast between Coruña and San Vicente de la Barquera and the eastern from Valencia to the Gulf of San Jorge will be included in the zone of total obscurity. Observers at Ferrol, Lugo, Oviédo, Gijon, Léon, Palencia, Burgos, Soria, Teruel and Saragossa will have some four minutes in which to make their notes. Madrid lies to the south of the zone of total eclipse.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

It was announced at the meeting of the trustees of the Catholic University of America on January 28 that the annual collection authorized for the university will amount to $100,000, and that this sum might be expected in each of the next nine years.

Teachers College, Columbia University, has received a gift of land valued at $50,000 from the heirs of William Earl Dodge.

Mr. Henry Phipps has given $20,000 to the Johns Hopkins Hospital to establish a clinic for consumptives.

Harvard University has received $6,000 for scholarships from the estate of Daniel A. Buckley.

The finance committee of Liverpool has recommended a grant of $50,000 to Liverpool University for the current year.

A fellowship in dermatology has been endowed at Liverpool University by Dr. Stopford Taylor.

The Association of American Universities will hold its next meeting at Yale University on February 18, 19 and 20. The program includes a discussion of uniformity of university statistics opened by Dr. Rudolf Tombo, Jr., of Columbia University; a discussion of the question 'Are the degrees of Bachelor of Science, Bachelor of Philosophy and Bachelor of Letters to be preserved or to be merged in the degree of Bachelor of Arts?' by Professor Richard Hudson, of the University of Michigan and by Professor Paul Shorey, of the University of Chicago, and a discussion on the administration, financial support and circulation of university publications, including doctor's dissertations and scientific journals and the general transaction of the business of the university, by President Ira Remsen, of the Johns Hopkins University, and Professor Charles Montague Bakewell, of the University of California. Papers will also be presented on the actual and the proper lines of distinction between college and university work by President Hadley of Yale University, and President Jordan of Stanford University. The admission of Brown University and New York University as members of the association will be considered.

Dr. Charles S. Howe will be inaugurated president of the Case School of Applied Science on May 11.

Mr. W. D. Gibbs, director of the Agricultural Experiment Station of the University of Texas, has been appointed president of the New Hampshire College of Agriculture and the Mechanic Arts.

Dr. H. D. Bergey has been appointed assistant professor of bacteriology at the University of Pennsylvania; Drs. Leo Loeb, William T. Cummins and Henry R. Alburger have been appointed assistant demonstrators of pathology; Dr. H. C. Richards has been appointed assistant professor of physics.

Dr. Oskar Eckstein, instructor in organic chemistry in Tufts College, has been appointed lecturer in chemistry in the University of Chicago.

Mr. Christopher Royce has been appointed instructor in mathematics at New York University on account of the illness of Professor Pomeroy Ladue.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 12, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE SUMMER'S WORK AT THE WOODS HOLE LABORATORY OF THE BUREAU OF FISHERIES (FORMER U. S. FISH COMMISSION).**

THE laboratory was thrown open on the sixteenth of June last for the nineteenth summer since the establishment of its present quarters, and scientific work was in progress until the end of September, after which time there remained but a single investigator. The work accomplished during the season is summarized below, together with mention of certain important lines of work which were planned and commenced. This statement has been prefaced by a brief account of the present equipment for scientific work at the station, although this latter of course varies but little from year to year.

### I. EQUIPMENT.

*Rooms.*—In addition to the large laboratory room with nine tables, there were fourteen private rooms at the disposal of investigators, all of which are provided with gas and electricity and otherwise equipped for research. To this list must be added the library, supply-room and aquarium, as well as the main hatching-room, which, as usual, was available for laboratory purposes from the end of the lobster-hatching season, early in July. Through the courtesy of Superintendent Locke, certain other portions of the fish-cultural plant were also at the service of investigators. Early in the summer im-

* Report to the Commissioner of Fisheries by the director of the laboratory.

portant improvements were made in the plumbing of the main laboratory, and some others have been authorized which will be carried out before the opening of the following season.

*Fleet.*—The steamer *Fish Hawk*, the yacht *Phalarope*, the tug *Blue Wing* and two steam launches were available during the whole or a part of the season. A catboat and an abundance of row-boats complete the list.

*Fish Pounds.*—Both of these were set this year in Buzzards Bay, at points not far removed from the station. A daily record was kept by Mr. Edwards of the species taken, together with a rough estimate of the number of each. Such records, which have been kept for many years past, furnish valuable data concerning the annual migrations of fishes. The pounds constitute also one of the important sources of supply for the materials of investigation.

*Library.*—This comprised (1) the permanent collection, including about 16,000 titles, mainly reprints donated by the authors, and reports of our own and foreign governments; and (2) the collections loaned for the summer months by Brown University and the College of the City of New York, comprising about 650 and 100 volumes respectively. A subject catalogue was commenced by the librarian, Miss R. McDonald, in addition to the author catalogue already on hand.

*Residence.*—One floor of the large residence building was, as usual, at the service of those who had been employed by the bureau to carry on special investigations.

## II. STAFF.

The staff of the laboratory during the season comprised a director, a librarian, a secretary, five salaried investigators, working upon special problems of interest to the fisheries, an assistant in charge of the supply-room, an assistant in charge of the fish pounds, and nine assistants, mainly college and medical students, doing miscellaneous work in the laboratory and in the field. To the above list must be added a collector, who is permanently attached to the station, and the crews of the various vessels while these are in service for the laboratory.

## III. INVESTIGATORS.

The total number of investigators who availed themselves of the privileges of the laboratory during the summer past was thirty, the greatest number at any one time being twenty. These men represented two government departments and sixteen educational institutions, ranging from Alabama to Vermont and west to Illinois. The average length of their stay at the laboratory was almost exactly six weeks, though a few stayed nearly or quite twice that time. A brief statement of the work done by each of the investigators is given below.

## IV. COLLECTING TRIPS.

Leaving out of account the daily visits to the pound nets, about forty collecting trips were made by the smaller steam craft. The localities visited were: Wareham, Monument Beach, Quisset, Hadley Harbor, Weepecket, Penikese, Cuttyhunk, Great Pond, Vineyard Haven, Muskeget, Katama, Gay Head and various points in Vineyard Sound. To this list must be added fifteen dredging trips made by the *Fish Hawk*, whose operations were confined almost exclusively to Vineyard Sound. The work of the *Fish Hawk* will be dealt with in a separate section. Mention should also be made of four days spent in camp by Mr. I. A. Field and an assistant at Menemsha Bight, Martha's Vineyard, where they were engaged in noting the fish taken in the numerous traps at that point, and of a journey to Provincetown, also by Mr.

Field, in quest of data relating to the food of the dog-fish.

The collector, Mr. Vinal N. Edwards, continued, as usual, the collection and preservation of fishes, fish parasites and other material of biological interest.

### V. SEMINAR.

A seminar or research club was established early in the season, and thereafter met weekly until near the close of the summer. It was thought possible that cooperation might be profitable in certain lines of work, and in general it was thought desirable that there should be some recognized medium by which investigators might profit by the results of one another's work. The experiment proved entirely successful and the meetings were well attended. The first few of these were devoted to a discussion of plans relating to the catalogue of local fauna and flora, and to the proposed dredging work of the *Fish Hawk*. At the later meetings, reports were presented by investigators upon their work at the laboratory.

### VI. CATALOGUE OF LOCAL FAUNA AND FLORA.

The compilation of a catalogue of the fauna and flora of the region, as far as known, was commenced by the director in cooperation with several others. The work, as projected, contemplates much more than a catalogue in the sense of a mere list of species. Certain data of practical or scientific interest are, when available, recorded for each of these. In order to permit of indefinite expansion, the whole record is to be in the form of a card catalogue, having eleven cards for each species. The *specific name* and *common name* (*local name*, whenever such exists) find their place on the first card; then follow in order '*relative abundance*,' '*geographical distribution*' (within region catalogued, of course), '*seasonal distribution*,' '*habitat*,' '*reproduction*' (breeding and spawning season, etc.), '*food*,' '*method of collecting*,' '*economic data*,' '*references*' and '*remarks*.'

The first step in the preparation of such a catalogue must consist in the sifting of the various published reports and papers containing the data desired. The classical report of Verrill and Smith upon the invertebrates of Vineyard Sound is, of course, one of the first to be utilized, as are also the numerous synopses of special groups published in the 'Bulletin' of the Fish Commission and elsewhere. In addition to these strictly faunistic papers, data relevant to the present work are to be found scattered through a large part of the biological literature emanating from Woods Hole—incidental observations on spawning-time, distribution, food and the like. Add to this the wealth of facts accumulated by Mr. Vinal Edwards, during his long experience as collector for the Fish Commission, and the large stock of information, as yet unrecorded, in possession of the numerous investigators who have occasion to collect material at Woods Hole. This only awaits a recognized receptacle, such as it is hoped that the present catalogue may become.

A fair start has already been made in the work of compiling this catalogue, many of the principal reports and synopses having been abstracted, and records of about 750 species having been entered. In this work Mr. Raymond C. Osburn cooperated with the writer, and several of the temporary assistants were engaged in the clerical work involved. The notes on the fishes, based upon the list prepared in 1898, by Dr. H. M. Smith, and supplemented by abundant data furnished by Mr. V. N. Edwards, are by far the most complete.

In this work, assistance has been promised by several systematists in compiling the records relating to their respective groups, and the active cooperation

of at least one of the botanists is assured, in the endeavor to have the flora, as well as the fauna, included in the catalogue. A liberal appropriation, which has been granted by the bureau, will enable the writer to continue this work during the present winter.

VII. DREDGING WORK OF THE 'FISH HAWK.'

The *Fish Hawk* arrived at Woods Hole on the nineteenth of July, and remained until September 10, during the greater part of which period she was at the disposal of the laboratory. It was thought that the admirable facilities for dredging possessed by this vessel could be put to greatest advantage by carrying out a systematic survey of the bottom of Vineyard Sound, a task which had not been undertaken since the days when Professor Verrill and his associates gathered the material for their reports on the invertebrate fauna of these waters.

Accordingly, dredgings were made at intervals of three fourths of a mile along parallel lines crossing the sound, these lines being constructed at intervals of one mile. Various sorts of dredges were employed, according to the character of the bottom, and frequently one spot or 'station' was covered by more than one sort of dredge. The usual physical data—density of water, character of bottom, temperature, etc.—were recorded for each station. Material for a complete record of the biological data has been preserved. The more familiar species were listed as they were taken aboard, record being kept of the condition and relative abundance of each. The remainder are at present represented by preserved specimens which await identification by experts. An even approximate list of the species taken can not, at present, be given. In all 82 'stations' are recorded in Vineyard Sound, ranging from Nobska Point to Gay Head. In addition, a trip was made to Crab Ledge, a shoal about seven miles east of Chatham, on Cape Cod, where seven stations were dredged.

It is planned that this dredging of the bottom of Vineyard Sound shall be continued and shall be supplemented by thorough work upon the shore life of this region, thus completing a biological survey of these waters. It is likely, too, that some sort of cooperation with the botanists will be arranged for. Such extensive plans can not, of course, be carried into effect without the employment of several specialists as assistants. The relation which such a survey would bear to the catalogue above discussed is obvious.

A regular form of collecting record blank was adopted for work of this character, and 2,500 copies were printed at the Government Printing Office.

Acknowledgment must here be made of the valuable assistance of Mr. R. C. Osburn, in connection with the dredging work; of the services of Dr. J. P. Moore and Dr. R. P. Bigelow, who identified respectively the annelids and the crabs collected; and of Dr. B. M. Davis and Miss Lillian McRae, who identified the algæ. Finally it must be mentioned that without the able and conscientious services of Capt. James A. Smith, in command of the *Fish Hawk*, the present measure of success would have been impossible.

VIII. OTHER INVESTIGATIONS.

In the brief statements given below, the language of the investigators themselves has been used as far as possible.

Robert Payne Bigelow, Ph.D., instructor in biology, Massachusetts Institute of Technology: (1) 'Stomatopoda of the Albatross Hawaiian Expedition,' (2) 'Brachyura of the Woods Hole Region.' During the spring there was placed in Dr. Bigelow's hands a collection of stomato-

poda gathered by the *Albatross* during the Hawaiian and Samoan expeditions of 1902. This collection was brought by him to Woods Hole, and his chief work during the summer was the sorting of this material and the identification of the known forms preparatory to making a detailed study of each species, with drawings. The collection is especially rich in larvæ, and the sorting of these has been done with a view to discovering series of stages, and the identification of larvæ with adult forms.

Dr. Bigelow also identified crabs collected by the *Fish Hawk,* and collected material in connection with his report on the Brachyura of the Woods Hole region, now in preparation.

Frank C. Carlton, graduate student in Harvard University: 'The Color Changes of some Fishes.' *Fundulus heteroclitus* was found to exhibit marked changes of color, depending primarily upon differences in the illumination. The skin is of a light gray color in the daylight, but is almost black in the dark. A fish put into a porcelain bowl and set in the light was found to change to a paler color, but the same fish put into a dish lined with black cloth remained dark, even if the illumination of the latter dish were the same as that of the white porcelain one.

The spinal cord of a fish which had previously shown the normal color changes was cut, and, after recovery from the shock of the operation, the fish was placed in the light. The posterior part now remained dark under all circumstances. This experiment seemed to prove that the change from dark to light is under nervous control.

From experiments in cutting the optic nerves of fishes whose color changes had previously been normal, it was concluded that light must influence the pigment cells through the eyes, since such fish did not show the reactions above described.

Leon J. Cole, Austin Teaching Fellow in Zoology, Harvard University: 'Studies upon Carp.' Material was worked over and notes compiled, based upon field work at various places on the Great Lakes during the past three summers. The results will be embodied in a report for the bureau.

Ulric Dahlgren, M.S., assistant professor of histology, Princeton University: Engaged in collecting material for histological studies.

George Wilton Field, Ph.D., assistant, Massachusetts State Board of Health: (I.) 'The Edible Lamellibranchs as a Source of Infection.' Together with Dr. C. A. Fuller, Dr. Field carried on, from August 10 to October 15, an investigation on the relations between shell-fish and sewage bacteria, and instituted experiments for the purpose of answering the following questions: (1) Are sewage bacteria (*Bacillus coli,* the type form) normal and usual inhabitants of shell-fish? (2) How soon after the introduction of *B. coli* into the water does it appear in the clam? (3) How long does *B. coli* live in ordinary sea water? (4) How long, under normal conditions, does *B. coli* remain alive and active in the intestine of the shell-fish? (5) Is it probable that the shell-fish digest *B. coli* and thus incidentally act as purifiers of the sewage-polluted waters, and, further, that by digesting *B. coli,* shell-fish may after a time become free from sewage-bacteria, and, therefore, harmless as food for man? (6) Examination to ascertain what anatomical region is most certain to give a true index of the presence of *B. coli.*

The methods used by Dr. Field and Dr. Fuller for securing proper conditions of infection with *Bacillus coli* and for main-

taining the normal conditions of life for the clams proved satisfactory. The results are probably to be published by the Massachusetts Board of Health in its annual report, and are believed to be of considerable importance.

(II.) 'The Lobster Problem.' At the request of Capt. J. W. Collins, chairman of the Fish and Game Commission of Massachusetts, Dr. Field secured at Woods Hole and Cuttyhunk important data concerning the lobster industry, bearing upon the biological importance of preserving the adult lobsters and permitting the catching of immature ones. Figures were obtained, indicating the commercial value, in terms of edible meat, of lobsters 8½, 9½ and 10½ inches long respectively; also the weights and measurements (length, weight and diameters of chelæ, thorax and abdomen) of upwards of eight hundred newly caught lobsters, coming from different sections; and some observations upon the relative numbers of mature and immature lobsters in the ocean. In connection with the recommendation of a law which would insure the perpetual protection of the adult lobster, experiments were made looking toward the adoption of a pot which would exclude lobsters above eleven inches in length, and permit the escape of those under nine inches. The result of this would be the automatic regulation of lobster catching to practically only those sizes which fell between nine and eleven inches. These results will be published as soon as possible.

Irving A. Field, Denison University: 'The Food of Certain Fishes of Little or no Food-value' (conducted for the bureau). The fishes chosen were the smooth dog-fish (*Mustelis canis*), killifish (*Fundulus heteroclitus*), cunner (*Tautogolabrus adspersus*) and toad-fish (*Opsanus tau*), all of which are common in the vicinity of Woods Hole. The purpose of the study was to seek for the possible economic relation which these fishes might bear to the fisheries industries. Are they destructive either to other fishes directly or to their food?

The method employed in these investigations was to take a great number of these fishes from various localities about Woods Hole and to preserve the stomach-contents of each as soon as possible after death. The various ingredients composing the contents of each stomach were ascertained quantitatively, the approximate percentage of each ingredient being estimated, and whenever possible, the total number of any given sort of animal which had been swallowed was determined. From data thus obtained a tabulated record was made out, including the date and locality of capture, number of specimens (fishes) examined, and the number of specimens containing each kind of food. A few preliminary experiments were also made with the dog-fish for the purpose of finding products that would make it of commercial value. Its food value was likewise tested. The results will shortly be ready for publication.

Caleb Allen Fuller, Ph.D., Providence, R. I: Assisted Dr. G. W. Field in the experiments above described.

Frederic P. Gorham, Ph.D., associate professor of biology, Brown University: 'Causes of Certain Fish Diseases' (conducted for the bureau). (1) An attempt to study the life-history of a fungus pathogenic to lobsters; to determine the paths by which the infection reaches the internal tissues of the lobster; to devise methods of combating the fungus. (2) With Mr. Marsh a very careful study was made of the causes operating in the production of the gas disease and 'pop-eye' in fishes kept in the aquaria (see below).

(3) Some experiments were made to determine the effects of different kinds of metal piping on fishes and other forms of life in aquaria. (4) Some experiments with phosphorescent bacteria obtained from sea water, to determine the part played by them in the production of phosphorescence in various crustacea.

John Y. Graham, Ph.D., professor of biology, University of Alabama: 'A Study of a Parasite of the Oyster (*Bucephalus cuculus* McC.).' This trematode, though very common in the region of Beaufort, N. C., and doubtless elsewhere on the southern coast, was not found in any of the oysters of the region near Woods Hole, although large numbers of the latter were examined, coming from Wareham River and Buzzards Bay. Dr. Graham was consequently obliged to confine his attention to the material which he had collected two years before at Beaufort. From a study of this, a careful account is now possible of the structure of the most advanced cercaria stages, which will perhaps give us a clue to the identity of the adult form, the latter being without doubt some species of the genus *Gasterostomum*.

Clarence W. Hahn, A.M., graduate student, Harvard University: (1) 'On Dimorphism in *Metridium marginatum.*' Regeneration experiments begun the year before and continued during the past summer led to the conclusion that the diglyphic Metridia are typical, and that the monoglyphic individuals arise by asexual budding from the base of the body or column. This method of reproduction is very common. The diglyphic condition is not transmitted asexually. The method of regeneration was also worked out. A new pair of directives is usually produced on the regenerated side of the young polyp. (2) 'On the Blood Parasites of the Turtle.' As a result of studies begun at Harvard and continued at Woods Hole, Mr. Hahn believes that he has established the existence of three kinds of adult individuals, with distinct life cycles similar to those described by Huitzi ('02) for *Drepanidium ranarum* of the frog. There was found to be an asexual form, which reproduced by a process of sporulation different from that of the sexual individual. In the sporulation of the latter, a process of mitosis was found to occur. The adult sexual hæmogregarine, which is worm-like in form, is believed by Mr. Hahn to be identical with the vermiform parasite described by Siegel ('03) in the leech, *Placobdella catenigera*.

Arthur D. Howard, M.S., graduate student, Harvard University: 'Minute Structure of the Rods of the Retina of Fishes.' Mr. Howard continued studies, previously made upon higher vertebrates, now using various fishes. Retinæ of the following forms, among others, were examined with the polarizing microscope, and confirmation of previous results obtained; butter-fish, squeteague, sand-dab, king-fish, menhaden, barracuda, eel, tautog, bonita, cutlass-fish, smooth dog-fish and skate.

Lynds Jones, M.S., instructor in zoology, Oberlin College: 'The Food of Marine Birds.' The investigations were made on Weepecket, Penikese and Muskeget Islands. Stomachs of young terns were examined, and the feeding of the young by the parent, as well as the feeding of the adult birds, were carefully examined. Mr. Jones gives the following estimate of the tern population of the various islands where they nest: Weepecket, 2,000; Penikese, 10,000; Muskeget, 80,000; total, 92,000 terns. The two species (*Sterna hirundo* and *S. dougalli*) are represented in about the proportion of two to one. The feeding habits and food of the two are the same. The

estimated number of fishes eaten in this region by terns in the course of one day is estimated by Mr. Jones as follows:

| | Per Cent. | |
|---|---|---|
| *Ammodytes americanus* | 80 | 736,000 |
| *Tautogolabrus adspersus* | 8 | 73,600 |
| *Mugil curema* | 4 | 36,800 |
| *Pollachius virens* | 3 | 27,600 |
| *Clupea* or *Pomolobus* | 3 | 27,600 |
| *Pseudopleuronectes americanus* | 2 | 18,400 |
| | 100 | 920,000 |

Mr. Jones concludes that the number of food fishes consumed by terns is a negligible quantity. The food of the gulls, loons, kingfishers, osprey and ducks was not studied.

Austin P. Larrabee, A.M., graduate student, Harvard University: 'The Effect of Heredity on the Dimorphism exhibited in the Optic Chiasma of Teleosts.'

Edwin Linton, Ph.D., professor of biology, Washington and Jefferson College: 'Investigations on the Parasites of Fishes' (conducted for the bureau). From August 13 to September 6, about 150 fishes, representing 32 species, were examined. In addition to this, a preliminary examination was made of material which had been collected by Mr. Vinal N. Edwards at various times during the past four or five years, comprising parasites from 27 species of fish and two mammals. The greater part of this collection consisted naturally of comparatively large and common species of parasites. In some cases, however, where the entire viscera had been preserved in formalin, many small and rare forms were found which would certainly have been overlooked by the general collector.

The plan of investigation of the fresh material consisted in making careful search for parasites in the alimentary tract and body-cavity, on the gills and occasionally in the muscular tissue of the fish. So far as time would admit, sketches and measurements were made, especially of varying states of contraction in the soft-bodied forms. Note was also made of the color, relative abundance, place of occurrence in the host, etc.; and particular attention was given to diseased conditions resulting from the presence of parasites. The nature of the food was also noted, since the character of the food may sometimes furnish a clue to the discovery of the intermediate host.

Thus far but little has been accomplished in working out the life history of the parasites of fishes. Some hint of the source of infection may be obtained by noting the relative abundance of parasites in the different seasons of the year. For this reason, such collections as those of Mr. Edwards are especially valuable.

Of forms which are new, or at least which have not been reported before, there were found: One species of the order Acanthocephala, two of the order Nematoda, six of the class Trematoda, and four of the class Cestoda. The results of this summer's work will be made the subject of a special report.

Joseph A. Long, graduate student, Harvard University: 'The Reaction of Eyeless (Blinded) Fish to Light.' The fish used were *Fundulus majalis* and *F. heteroclitus*. By using an aquarium provided with an electric light, and covered with black cloth in such a way that one half was darkened and the other half was in bright light, it was found that normal fish in good condition were decidedly phototropic in a positive way. After observations had been made on the normal fish, the optic nerves were cut, and the previous experiments repeated. No evidence was found that in *Fundulus* there were sense organs in the skin or lateral line that were responsive to light.

M. C. Marsh, pathologist of U. S. Bureau of Fisheries: 'The Causes of the

Gas-disease of Fishes.' This work, which was carried on jointly with Professor Gorham, was directed toward discovering the cause of 'pop-eye' due to gas, and the causes of mortality among fishes in the local aquarium whether with or without 'pop-eye.' It was found that the sea water from the supply pipes of the station, when delivered below the surface of the water in an aquarium, was fatal to most species of fishes after a longer or shorter time, *Fundulus* being most resistant; that when the water delivered was first somewhat broken up, causing it to spatter or spray, the mortality tended to lessen, and 'pop-eye' to decrease; that when the deaeration process was sufficiently complete, the 'pop-eye' and the mortality were prevented completely.

By placing fishes (scup) under various air pressures greater than the atmospheric, in the same water which ordinarily produced 'pop-eye' and killed the fish, the 'pop-eye' and the mortality were found to be checked, being inhibited altogether by a pressure of between six and seven pounds per square inch.

Scup adjusted to surface pressure for one week were as susceptible as those brought directly from the fish traps, which had probably come from somewhat deeper water. Artificial reduction of air pressure produced the same gaseous lesions as those which had been shown by fishes in the aquaria under the influence of the local water supply, viz., 'pop-eye,' gas blebs, death with free gas in the blood vessels, according to the degree and the duration of the reduction. Death occurred in a few hours at a pressure reduced to less than that of twenty inches of mercury.

Determinations showed that the aquarium water has a proportion of dissolved gas considerably in excess of that from the basin or harbor. This excess is believed by the investigators to be caused by the hydrostatic pressure of the supply system, in conjunction with leaks in the suction pipe which admit air to the water immediately prior to its being pumped to the supply tank. This excess of gas in solution consists of one or more of the constituents of air.

The immediate cause of death was usually found to be the presence of free gas in the blood vessels. According to the investigators, this free gas is formed in the following manner: The blood of fishes living in this supersaturated water takes up, while in the gill capillaries, more than the usual amount of gases, thus reaching nearly or quite to the saturation point. These gases are, however, liberated as soon as the blood becomes raised to a higher temperature in the systematic circulation, thus continually accumulating in the vessels.

Samuel Steen Maxwell, Ph.D., instructor in physiology, Harvard Medical School: 'Comparative Study of Muscular Tonus.' The phenomena of muscular contraction were studied in a somewhat wide range of forms. Especial attention was given to the occurrence of spontaneous or rhythmic contractions in muscles or muscle groups separated as completely as possible from the influence of nervous tissues. Among the forms investigated were *Nereis, Crepidula, Modiolus, Mytilus, Homarus, Libinia, Limulus, Carcinus, Mnemiopsis* and *Gonionemus*.

In order to retain the muscle alive for a sufficient period of time, it seemed necessary to find a solution which could be used upon the tissues of marine animals in the same way as the customary physiological salt solution is used upon the tissues of land animals, and considerable time was devoted to experiments along this line.

A full report of the experiments will be published as soon as possible.

J. Percy Moore, Ph.D., instructor in zoology, University of Pennsylvania: 'A Synopsis of the Annelids of the Woods Hole Region' (prepared for the bureau). The families Cirratulidæ, Maldanidæ, Ampharetidæ, Terebellidæ and Sabellidæ have been completed. Several new species were discovered and descriptions prepared for publication, one of the most striking of which is a large and handsome species of *Trinia*. A number of hitherto unrecorded species have been added to the known fauna, among them tropical species of *Hipponoe* and *Euphroryne* transported by the Gulf Stream on barnacle-laden logs. *Tomopteris* was taken in the tow at the Fish Commission wharf. Valuable data concerning the exact distribution of species were derived from the trawlings of the *Fish Hawk* and from shore collections.

Raymond C. Osburn, graduate student, Columbia University. Mr. Osburn cooperated, as a salaried assistant, in the compilation of the card catalogue of local fauna and flora (see above), and in the work upon the dredging material obtained by the *Fish Hawk*.

George Howard Parker, Ph.D., assistant professor of zoology, Harvard University: 'Physiology of the Lateral-line Organs' (research conducted for the bureau). Six species of fishes were tested: dog-fish, skates, killifish, scup, toad-fish and winter flounder. In each species individuals with normal lateral lines, and those in which the nerves going to the lateral-line organs had been cut, were tested. The most complete series of tests covered temperature, salinity, oxygen pressure, carbon dioxide, foulness, water-pressure, water-currents, water-vibrations of high and of low frequency. Differences between fishes with and without lateral-line organs were noticed only in relation to vibrations of low frequency (six per second). It was, therefore, concluded that the lateral-line organs are stimulated by water vibrations of low frequency.

Henry Farnham Perkins, Ph.D., instructor in biology, University of Vermont: 'Studies of the Morphology of Hydromedusæ.' Collections were made in the eel pond during a preliminary visit early in May, and many immature specimens of *Gonionema murbachii* were taken, also some *Willia ornata* and scattering specimens of other genera. Dr. Perkins's aim was to find the young of *Gonionema* in the process of transformation into the medusa form, but the earliest of the young stages found possessed all of the adult characters. Many young medusæ were preserved with a view to studying the development of the tentacles and sense organs. All of these specimens showed the remarkable scheme of origin of the tentacles mentioned in a previous paper by Dr. Perkins. A number of specimens of *Hybocodon prolifer* were taken in the deep water outside the harbor. Many of these exhibited not only the asexual reproduction by budding at the base of the parent tentacle, described and figured by Agassiz and others, but also sexual reproduction in the same individuals, larvæ being developed in the ectodermal tissue of the manubrium, and escaping as actinulæ.

July 6 to August 4, mature specimens of *Gonionema* were collected on nearly every day, and the eggs obtained from these were reared in a variety of ways with a view to having the larvæ mature in the laboratory. Many thousand polyps are now under observation. A careful study of the sexual reproduction of *Hybocodon prolifer* was made during this time and a paper was prepared for publication. Constant watch was kept for specimens of medusæ in the waters about Woods Hole,

but very few specimens were found, and none at all of unusual interest. Experiments were carried on in order to find under what artificial conditions it was possible to rear larvæ of various medusæ, and to keep the adults in good state for observation. Observations were also made upon the degeneration of tentacles in *Gonionema*.

Amos W. Peters, Ph.D., instructor in physiology, University of Illinois: 'Studies on the Phosphorescence of Ctenophores.' Efforts were directed toward the following ends: (1) To follow the phenomenon back through the ontogeny of the animal; (2) to the determination of the influence of light upon the deposition of eggs; (3) to the relations between phosphorescence and various stimuli.

W. O. Richtman, expert in pharmacognosy, U. S. Department of Agriculture: Assisted Dr. True in his experiments upon artificial sea waters.

G. F. Ruediger, M.D., Memorial Institute for Infectious Diseases, Chicago (Rush Medical College): 'Bactericidal Properties of Sera of Marine Animals.' The object of this work was to find a normal blood serum, in cold-blooded animals, which would be destructive to streptococci. Sera from butter-fish, dog-fish, conger-eel, flounder, mackerel, dusky shark, sand-shark, scup, squeteague, butterfly-ray, sting-ray, common skate, squid, lobster, spider-crab, king-crab, snapping-turtle, painted turtle and spotted turtle were used. Streptococci were found to grow well in all of these sera, excepting those of the painted turtle and spotted turtle. These two sera seemed to kill off large numbers of organisms from some cultures of streptococci, other cultures, however, not being affected. Heating the serum destroyed its bactericidal properties. An attempt was also made to immunize dog-fish, but lack of time prevented conclusive results.

Geo. G. Scott, M.A., tutor in the College of the City of New York; assistant in charge of supply-room, at the laboratory: 'Studies of the Gregarines.' Numbers of invertebrates were examined for gregarines. None were found in the blue-crab, lady-crab, spider-crab, king-crab, squid nor *Phascolosoma*. In the lobster, specimens of the gregarine, *Porospora gigantea* were found, almost every lobster having cysts of this parasite in the folds of the rectum. Gregarines were also found in *Cirratulus*, *Nereis* and *Clymenella*. In *Cynthia*, the movements of a gregarine were observed carefully and camera drawings were obtained, representing the changes of shape. Several specimens of *Amphitrite* showed pathological enlargements beneath the ectoderm of the body wall. These are as yet undetermined.

John A. Shott, A.M., professor of biology and physics, Westminster College: 'Phototaxis in Copepoda' (in cooperation with Dr. Parker). The problem was to determine the reactions of the copepods in a graded field of light when they were started toward the source of light. The work was done during the last two weeks of July, at which time the copepods were difficult to obtain, so that the results were not conclusive.

Grant Smith, graduate student, Harvard University: Assisted Dr. True in experiments upon artificial sea water, also carried on experiments upon phototactic responses of star-fish.

Francis Bertody Sumner, Ph.D., instructor in zoology, College of the City of New York; director of laboratory: (1) 'Card Catalogue of Local Fauna and Flora,' commenced, with cooperation of Mr. R. C. Osburn (see above); (2) 'Dredg-

ing Survey of Vineyard Sound' (see above); (3) 'A Statistical Study of *Fundulus majalis* with a view to the determination of selective characters.' During the preceding summer large numbers of this fish were placed in aquaria from which the water was turned off. When about half had died, the living and the dead, *i. e.*, the survivors and non-survivors, were preserved. This year, nearly a thousand of these fish were carefully measured by two assistants, Messrs. C. R. Metcalf and W. H. Curtiss. Nine measurements were made for each fish. The rather formidable task of making the desired computations from these figures has scarcely been commenced, but enough has been done to show the existence of certain measurable characters of selective value.

Millett T. Thompson, Ph.D., instructor in zoology, Collegiate Department, Clark University: (1) 'Crustacean Metamorphosis'; (2) 'Studies of the Head and Alimentary Canal of Diptera.'

Rodney H. True, Ph.D., physiologist of Bureau of Plant Industry: 'Artificial Sea Waters as tested in Aquaria' (assisted by Mr. W. O. Richtman). At the suggestion of Mr. W. De C. Ravenel, representative of the Bureau of Fisheries at the St. Louis Exposition, experiments were made under the authority of the Secretary of Agriculture, and of the Commissioner of Fisheries in order to determine, if possible, in how far it may be practicable to make artificial sea water, capable of sustaining marine plant and animal life.

Experiments were made with artificial sea water prepared in two ways: (1) By dissolving in distilled water the complete salts of the sea, obtained by evaporation; (2) by dissolving in distilled water chemically prepared salts in proportions determined by analysis. The *Challenger* analyses by Dittmar were used. Aquaria were provided with artificial waters prepared according to each of these methods and with sea water dipped up from the current at the end of the wharf at the Woods Hole station. Two sets of such aquaria were prepared: (1) Standing aquaria kept at constant salt content by the addition of fresh water; (2) aquaria through which a small stream of water was kept flowing, providing thereby a system of closed circulation.

Aquaria thus prepared were stocked with both plant and animal life; the plants most used being green forms common at Woods Hole: *Cladophora, Enteromorpha, Ulva* and *Aghardiella tenera*. Many types of animal life were studied, including, especially, sea-anemones (*Metridium*), star-fish (*Asterias*), medusæ (*Gonionemus*), squid (*Loligo*) and fish (silversides, scup, pipe-fish, etc.).

The general result may be summed up as follows: Sea-anemones seemed to flourish during the period under observation in all media. Star-fish survived and behaved normally in the water made from evaporated sea salt, in cases, however, showing symptoms of injury in the synthetic solution. *Gonionemus* survived for several weeks in both solutions, but appeared to suffer from other forms of life with which it came in contact. The squid could not be made to survive for more than a few days in any medium, artificial or natural. They died in the synthetic solution in less than ten minutes with violent symptoms; they survived in the other artificial solution as long as in the natural sea water. Fish seemed in all cases to live as well in the artificial solution as in the natural, including delicate forms, like *Menidia*. Several other forms of fish and invertebrates were tested in various ways, with the general result that the artificial solution made from the salt obtained by evaporation permitted survival to a degree

not clearly different from that seen in sea water. The synthetic artificial solution seemed equally favorable to most forms, but distinctly less so to a few.

Francis B. Sumner.

## SOCIETY OF THE VERTEBRATE PALEONTOLOGISTS OF AMERICA.

The second meeting of this society was held at Philadelphia, December 29, 1903, in the Biological Hall of the University of Pennsylvania. In the absence of the president, Professor S. W. Williston, the chair was taken by Professor H. F. Osborn.

The following are abstracts of papers which were read and discussed:

*A Remarkably Preserved Specimen of a Pelycosaur Collected During the Last Summer in Texas:* Dr. E. C. Case.

The specimen has afforded a nearly complete skull and the anterior part of the vertebral column, with the incomplete fore limbs of both sides. The most important addition to our knowledge is in the anatomy of the articular region of the skull and lower jaw. The specimen shows that the author, in collaboration with Dr. Baur, was in error in ascribing to the articular region of the skull what belongs to the articular region of the lower jaw. The quadrate is, therefore, not a depressed bone largely covered by the bones of the temporal region, squamosal and jugal, but it is elevated and very similar in appearance and relations to the same bone in *Sphenodon.* There is a foramen between the lower end of the quadrato-jugal and the quadrate, as in *Sphenodon.* The finding of this foramen removes the last possible question as to the position of the Pelycosauria in the order Rhynchocephalia. There are two temporal arches present.

*In the Matter of Menaspis:* Dr. Bashford Dean, Columbia College.

Professor Bashford Dean discussed the relationship of the puzzling Permian fish, *Menaspis,* pointing out that on the evidence of an unfigured specimen in the Berlin Museum, which, thanks to the courtesy of Professor Jaekel, he had recently had the privilege of examining, there were grounds for regarding this form as distinctly chimæroid. The present specimen retains the dental plates, and from their size leads us to conclude that the region of the fossil regarded by earlier writers as the hindmost trunk region (terminating in blunt spines) is in reality the occiput. He compared the tuberculated spines of *Menaspis* with those of *Myriacanthus,* referring especially to an unfigured specimen of this form to which Professor E. T. Newton called his attention in the Paleontological Museum in Jermyn Street. The puzzling non-tuberculated spines of *Menaspis,* on the other hand, best correspond to the so-called lip cartilages of *Squaloraja.* Such structures, moreover, would be apt to take a position dorsal to the antero-ventral lateral head spines during fossilization. Accepting this comparison, *Menaspis* indicates that in matters of dermal defenses and teeth the Permian chimæroid resembled contemporary cestraciont sharks.

*On Some Famous Old Collections and Early Studies of Monte Bolca Fishes:* C. R. Eastman.

This paper reviewed the pre-Linnæan discussions as to the nature and origin of the famous fossil fish fauna of Monte Bolca, in northern Italy, with a notice of the principal contributions to the literature made during the last century. The history was given of several large Veronese collections containing important type material, and where the latter had become dispersed, the present location was indicated of such as is now preserved amongst different museums.

*On the Finding of Skulls of Trionychidæ in the Bridger Deposits of Wyoming:* Dr. O. P. Hay, American Museum of Natural History.

More than twenty species of fossil Trionychidæ have been described from the Cretaceous and Tertiary deposits of North America. All these have been based on more or less incomplete shells. No skulls have hitherto been found. During the past summer a party from the American Museum of Natural History was engaged in collecting in the Bridger Eocene of Wyoming. Among many other turtle remains secured were two skulls of Trionychidæ. One of these is very large, having a total length of more than six inches. The lower jaw is missing. The form is strikingly like that of the skull of *Platypeltis ferox* of the southern states; but the snout is broader, the inter-orbital space is wider and the choanæ are constricted, as in *Aspidonectes sinensis*. The species is named *Aspidonectes tritor*. A skull of another species is much smaller and is accompanied by the lower jaw.

These specimens show that since the Eocene there has been no important change in the structure of the Trionychidæ. Dr. Baur was led to the same conclusion regarding the Trionychidæ of the Upper Cretaceous, from the examination of shells and limb bones from the Laramie of Wyoming. Shells from the still older deposits of the Judith River and Belly River beds similarly give indications that the members of this group have undergone little change since the early periods of the Upper Cretaceous. We must, therefore, look to discoveries in the fresh-water deposits of the Lower Cretaceous or of the Jurassic for light on this group.

*The Grasping Power of the Manus of Ornithomimus altus Lambe:* Lawrence M. Lambe, of the Geological Survey of Canada.

The description of the manus is based on materials found by the writer in the Belly River deposits of Alberta, Canada. The pes of *O. altus* shows that the animal was adapted to swift running. The manus can not yet be wholly reconstructed, but the claws were quite different from those of *O. sedens*. *O. altus* may be regarded as the successor of *Ornitholestes hermanni* Osborn, and there are many similarities in the manus of the two. The manus of *O. altus* is much stouter and less elongate, but it probably had equally great grasping power. The phalanges of what is supposed to be the second finger were described. A channel between the condyles of the distal end of the first phalanx extends through an angle of about 223°. The amount of rotation which the second and distal phalanges may make is very great. *O. altus* probably pursued a rapid prey and grasped it tenaciously with its fore limbs. Evidently the claws were long and sharp.

*On Some Marine Fossils in the Titanothere Beds:* Dr. F. B. Loomis, Amherst College.

On Bear Creek, near the Cheyenne River, South Dakota, in the lower part of the Titanothere horizon of the Oligocene, were found about seventy-five baculites and parts of a *Platecarpus*, these being Ft. Pierre species. These occurred in concretions and had a limited distribution. Their presence was explained by river action, the fossils having been excavated from the Ft. Pierre and redeposited during the building up of the Titanothere beds.

*The Relationships of the Phytosauria:* Dr. J. H. McGregor, of Columbia University.

This group of reptiles, represented by the belodonts of the European and American Triassic, were regarded by Huxley as constituting a primitive division of the crocodiles, for which he proposed the sub-

ordinal name Parasuchia. Though Huxley's view has received quite general acceptance, several paleontologists, notably Marsh, Baur and E. Fraas, have observed certain resemblances to *Sphenodon* and the dinosaurs. The present studies of the group, based chiefly upon extensive material recently discovered in Germany and in North America, have cleared up most of the doubtful points of the skeletal morphology, and it may be said that, save for the carpus and tarsus, the phytosaurian skeleton is now pretty well known. Nearly all the newly discovered structures indicate that the affinity to crocodiles is much more remote than Huxley supposed, and certain characters of the skull and atlas alone preclude the possibility that these forms were ancestral to crocodilia. The strong general resemblance between the two groups is chiefly superficial or parallel adaptation to similar habit and environment.

The relationship of phytosaurs to carnivorous dinosaurs, on the contrary, is obscured by the adaptive or secondary differences correlated with bipedal habit in the latter animals; but careful comparison of the skeletons shows that the relationship in this case is scarcely more remote than the relationship with crocodiles. The group which undoubtedly stands nearest the phytosaurs comprises the small armored Aëtosauria; in fact, the phytosaurs are chiefly distinguished from these animals by the prenarial elongation of the snout. For this reason it seems best to place the two groups as suborders within a single order, to designate which Huxley's subordinal name Parasuchia may be taken in a more inclusive sense and raised to ordinal value. The derivation of these Parasuchia from Rhynchocephalian ancestors scarcely admits of doubt; they might be briefly described as Rhynchocephalia which have acquired strongly bicipital ribs, thecodont dentition and a dermal armature.

Evidence was also adduced to show genetic affinity between Phytosauria and Ichthyosauria. Many structures, especially in the skull and limb girdles, indicate derivation of both from a common ancestor at no very remote period.

*On the Position of the Bones of the Forearm in the Opisthocœlia or Sauropoda:* Henry Fairfield Osborn.

In the Sauropoda the forearm is modified in adaptation to support a very great weight in a manner entirely analogous to that in the Proboscidea, namely, the forearm is completely rotated inward, bringing the thumb, or first digit, on the internal side of the foot; the ulna is also enlarged proximally until it covers the entire posterior face of the radius. This gives rise to a deceptive appearance of the shafts of the radius and ulna, and has led to the statement that these elements do not cross. Careful study of the entire forearm, however, shows that the upper end of the radius rises from the radial condyle which is on the external side of the lower end of the humerus below the deltoid crest; on the front surface of this condyle is a groove for the main flexor of the forearm; immediately below this condyle the radius is articulated, and on its front face is seen the rugosity for the attachment of the flexor tendon which passes through the groove in the radial condyle above; these relations fix the radius on the *external* side of the limb proximally; distally the radius is found on the *internal* side articulating with the scapho-lunar and supporting the radial digit, or thumb. The ulna is also strongly developed on the external side of the limb proximally, and extends behind the radius around to the internal side, its primary position; the shaft of the ulna descends and articulates with the ulnare on the external side of the limb inferiorly. Thus when seen in front view the shafts of the radius

and ulna actually cross each other, although as in the Proboscidea this crossing is much less apparent, owing to the great proximal expansion of the ulna.

*On the Use of the Sandblast in Cleaning Fossils:* Henry Fairfield Osborn.

The introduction of the compressed air chisel by the Field Columbian Museum has greatly reduced the cost of removing rock from fossils. This chisel has been introduced also in the National Museum with success. For larger masses of rock it answers every purpose. The writer has recently been experimenting with a sandblast, driven by a compressed air engine, with admirable results. This method is peculiarly adapted to the finer work. It should be used under fifty-pound pressure, with tubes of fine diameter. Although not thoroughly tested as yet it promises to give remarkable results both in cleaning surfaces and in removing the matrix in the cavities of small skulls. Combined with the compressed air chisel it will probably reduce the cost of preparing fossils to one third of that involved by the use of hand tools.

*Conclusive Paleontological Evidence for the Tritubercular Theory:* Henry Fairfield Osborn.

That part of the tritubercular theory which homologizes the cusps composing the main triangle in the upper and lower grinding teeth of mammals, has been seriously questioned of late; first, because it does not accord with all the embryological evidence, second, because the superior premolar teeth appear to afford a demonstration that the upper molar teeth evolved in a manner which was subsequently pursued by the premolars. The tritubercular theory has been steadily losing ground; some authors have recommended that the cusp homologies and terminology be totally abandoned. A fresh investigation of the paleontological material available has, however, demonstrated beyond question the truth of the theory in its original form.

The superior molars of *Triconodon* and of *Peralestes* in the British Museum support the original view that the cusp (protocone) homologous with the reptilian cone is internal or lingual in position. Through the kindness of Professor Charles E. Beecher, the superior molar teeth of the Jurassic *Dryolestes* in the Yale Museum have been reexamined, and are found to correspond exactly both with the original description of Marsh and with the conditions set forth in the original tritubercular theory. The main cusp, or protocone, is internal and supported on a stout fang; the secondary cusps, representing the para- and metacones, are external and supported on lesser fangs. This evidence, together with that deduced from comparative anatomy and paleontology, establishes the tritubercular theory beyond further question.

*A Reclassification of the Reptilia:* Henry Fairfield Osborn.

The Reptilia are divided into two subclasses: (1) Synapsida, including the Cotylosauria, Anomodontia, Sauropterygia and Testudinata. The Anomodontia are divided into the Therocephalia (Broom), the Theriodontia (Cynodontia Owen), the Dicynodontia, representing progressive phases of evolution of the skull and specialization of the teeth. Of these the Theriodontia stand nearest the Mammalia. (2) Diapsida, embracing the new superorder Diaptosauria, which includes the seven orders and suborders Procolophonia, Protorosauria, Proganosauria, Gnathodontia, Choristodera, Pelycosauria and Rhynchocephalia. The remaining Diapsidan orders are the Parasuchia (= Phytosauria), Ichthyopterygia, Crocodilia, superorder Dinosauria, superorder Squamata and the order Pterosauria. Birds sprang

from a stem near that which gave rise to the Dinosauria.

The paper is an abstract, with some additions, of the memoir 'The Reptilian Subclasses Diapsida and Synapsida and the Early History of the Diaptosauria' (*Mem. Amer. Mus. Nat. Hist.,* Vol. I., November, 1903).

*On the Primary Components of Vertebræ and Their Relations to Ribs:* Henry Fairfield Osborn. Read by title.

The vertebræ of the Stegocephala and of certain Permian Reptialia and the embryonic vertebræ of *Hatteria* establish beyond question the fact that there are four pairs of primary components, to which the names neurocentra, pleurocentra, hypocentra and hypocentra-pleurale may be given. Each is present in pairs on opposite sides of the notochord and neural tube. The 'neurocentra' correspond with the neural arches or neuropophyses of authors. The 'pleurocentra' (Cope) form the main components of the vertebræ in the Reptilia, Aves and Mammalia, and probably also in the Amphibia, although this fact has been questioned by Baur and Cope. The 'hypocentra' were first named by Gaudry, and subsequently termed 'intercentra' by Cope; they are primarily paired elements lying on either side of the notochord below and anterior to the pleurocentra; by Cope and Gadow it has been held that they form the main components of the vertebræ in certain if not in all Amphibia. The 'hypocentra-pleurale' (Fritsch) lie in pairs below and posterior to the pleurocentra; they are only found in certain Stegocephala. The vertebral complex thus made up is modified by the degeneration of the hypocentra-pleurale and in many forms of the hypocentra; by the development of the pleurocentra uniting with the neurocentra to form the centrum and neural arches.

Both on paleontological and embryological evidence the ribs always rise primarily opposite the hypocentra; they are thus placed between the pleurocentra and may be described as 'intervertebral' or 'intercentral.' The capitulum of the rib is hypocentral while the tuberculum is pleurocentral in attachment. Secondarily the capitulum may migrate to the side of the pleurocentrum, and the tuberculum to the side of the neurocentrum. This rib migration, observed independently in many different orders of reptiles, proves that the position of the head of the rib can not be adduced as evidence of the homology of that portion of the vertebral complex to which it is attached.

Mr. G. I. Adams, of the U. S. Geological Survey, read a paper entitled 'The Differentiation of the Permian in the United States, and the Diagnostic Value of Reptiles as Indications of Permian Age.' No abstract has been furnished.

Other papers by Messrs. J. C. Merriam, H. F. Osborn, Wm. Patten, E. S. Riggs, W. J. Sinclair and S. W. Williston were read by title.

Before adjournment Professor H. F. Osborn was elected president and O. P. Hay secretary for the ensuing year.

O. P. Hay,
*Secretary.*

## *THE MEMBERSHIP OF THE AMERICAN ASSOCIATION.*

The following persons have completed membership in the association since the publication of the list contained in Science of December 25, 1903:

Adams, Charles Francis, Head of Science Dept., Central High School, Detroit, Mich.

Aitken, Robert G., Lick Observatory, Mount Hamilton, Cal.

Alt, Adolph, M.D., 3819 W. Pine Ave., St. Louis, Mo.

Andrews, Clement Walker, Librarian, The John Crerar Library, Chicago, Ill.

Banta, Arthur M., Instructor, Indiana University, Bloomington, Ind.

Barbour, Miss Carrie Adeline, Dept. Geology, University of Nebraska, Lincoln, Nebr.

Basquin, Olin H., Associate Professor of Physics, Northwestern University, Evanston, Ill.

Bell, John Everett, Care The Stirling Co., Barberton, Ohio.

Bierbaum, Christopher H., Consulting Engineer, 330 Prudential Building, Buffalo, N. Y.

Bigelow, W. D., Bureau of Chemistry, Dept. of Agriculture, Washington, D. C.

Bissell, G. W., Professor of Mechanical Engineering, Iowa State College, Ames, Iowa.

Bonnet, Frederic, Jr., 2719 Russell Ave., St. Louis, Mo.

Brooks, Charles, Botanical Laboratory, Univ. of Mo., Columbia, Mo.

Brown, Linus Weed, ex-Chief Engineer, City of New Orleans, 741 Carondelet St., New Orleans, La.

Browning, William, M.D., 54 Lefferts Place, Brooklyn, N. Y.

Burrill, Thomas J., Professor of Botany, University of Illinois, Urbana, Ill.

Burton, E. F., Demonstrator in Physics, University of Toronto, Toronto, Ontario, Canada.

Chamberlain, Clark Wells, Professor of Physics, Denison University, Granville, Ohio.

Cramer, Gustave, Pres. G. Cramer Dry Plate Co., St. Louis, Mo.

Crampton, C. Ward, M.D., 160 West 119th Street, New York, N. Y.

Curtis, Winterton C., Ph.D., Instructor in Zoology, University of Missouri, Columbia, Mo.

Daugherty, Lewis S., Professor of Biology, State Normal School, Kirksville, Mo.

Davies, Arthur Ernest, Ph.D., Ohio State University, Columbus, Ohio.

Detweiler, Andrew J., M.D., State Board of Health, Columbia, Mo.

Douglas, Archer Wall, 5101 McPherson Ave., St. Louis, Mo.

Earhart, Robert F., Asst. Professor Physics, Ohio State University, Columbus, Ohio.

Eikenberry, William Lewis, Instructor in Botany, High School, St. Louis, Mo.

Evans, Thomas, University of Cincinnati, Cincinnati, Ohio.

Eycleshymer, Albert Chauncey, Department of Anatomy, University of Chicago, Chicago, Ill.

Fischer, Charles E. M., Care Western Electric Co., 259 S. Clinton St., Chicago, Ill.

Folsom, Justus Watson, Instructor in Entomology, University of Illinois, Champaign, Ill.

Fox, Philip, Carnegie Assistant at Yerkes Observatory, Williams Bay, Wis.

Galloway, David Henry, M.D., Payette, Idaho.

Gazzam, Joseph M., Lawyer, 611–614 Real Estate Trust Bldg., Philadelphia, Pa.

Glasgow, Frank A., M.D., 3894 Washington Ave., St. Louis, Mo.

Gorham, Frederic P., Associate Professor of Biology, Brown University, Providence, R. I.

Gould, Charles Neton, Professor of Geology, University of Oklahoma, Norman, Okla.

Graf, August V., 1325–29 S. 7th St., St. Louis, Mo.

Greeley, Arthur White, Asst. Professor of Zoology, Washington University, St. Louis, Mo.

Greenway, James C., 667 Madison Ave., New York, N. Y.

Gunsaulus, Rev. Frank W., President Armour Institute, Chicago, Ill.

Hairgrove, John Whitlock, M.D., Jacksonville, Ill.

Ham, Miss Clara Eleanor, Instructor in Biology, Northfield, Mass.

Haukinson, Thomas L., Asst. in Biology, E. Ill. State Normal School, Charleston, Ill.

Hess, Selmar, Publisher, 122–124 Fifth Ave., New York, N. Y.

Huston, Henry A., 134 Laclede Building, St. Louis, Mo.

Jones, Arthur Taber, Instructor in Physics, Purdue University, La Fayette, Ind.

Kern, John H., M.D., 1317 Madison St., St. Louis, Mo.

Knab, Frederick, Entomological Artist, Urbana, Ill.

Knox, Geo. Platt, Teacher of Chemistry, 5178A Morgan St., St. Louis, Mo.

Landacre, Francis L., Associate Professor of Zoology and Entomology, Ohio State University, Columbus, Ohio.

Latham, Vida A., M.D., 808 Morse Ave., Rogers Park, Chicago, Ill.

Leith, Charles Kenneth, Professor of Economic and Structural Geology, University of Wisconsin, Madison, Wis.

Lewis, E. P., Associate Professor of Physics, University of California, Berkeley, Cal.

Lightner, Calvin R., M.D., 2313 Washington Ave., St. Louis, Mo.

Lischer, Benno Edward, 2313 Washington Ave., St. Louis, Mo.

Lutz, Frank Eugene, Assistant in Zoology, University of Chicago, Chicago, Ill.

Lyman, Elmer A., Professor of Mathematics, Mich. State Normal School, Ypsilanti, Mich.

McBeth, William A., Asst. Professor of Geography, State Normal College, Terre Haute, Ind.

McClure, Geo. E., 4418 Arsenal St., St. Louis, Mo.

McElfresh, William Edward, Asst. Professor of Physics in Williams College, Williamstown, Mass.

McKee, Ralph Harper, Professor of Chemistry, Lake Forest University, Lake Forest, Ill.

Mallinckrodt, Edw., Jr., 26 Vandeventer Place, St. Louis, Mo.

Marquis, J. Clyde, La Fayette, Ind.

Miller, Louallen F., Instructor in Physics, University of Wisconsin, Madison, Wis.

Mills, John, Instructor in Physics, Western Reserve University, Cleveland, Ohio.

Mohler, George H., Fremont Normal School, Fremont, Nebraska.

Neal, Herbert V., Knox College, Galesburg, Ill.

Nelson, N. L. T., Instructor in Botany, Central High School, St. Louis, Mo.

O'Donoghue, Martin, Westernport, Md.

Oleson, Olaf M., Fort Dodge, Iowa.

Pauls, Gustavus, St. Louis Altenheim, St. Louis, Mo.

Pearl, Raymond, Ph.D., Instructor in Zoology, University of Michigan, Ann Arbor, Mich.

Peters, Amos W., Instructor in Zoology, University of Illinois, Urbana, Ill.

Piper, Charles V., Office of Agrostologist, Department of Agriculture, Washington, D. C.

Porter, Albert B., 1232 Forest Ave., Evanston, Ill.

Poth, Harry A., Technical Brewer, 216 N. 33d St., Philadelphia, Pa.

Praeger, William Emilius, Department of Botany, University of Chicago, Chicago, Ill.

Priest, Henry, Ph.D., Dean of College of Letters and Science, St. Lawrence University, Canton, N. Y.

Proctor, Chas. A., Department of Physics, University of Missouri, Columbia, Mo.

Pyle, William Henry, Supt. Vandalia City Schools, Vandalia, Ill.

Rea, Paul M., Professor of Biology and Geology, College of Charleston, Charleston, S. C.

Reed, Howard Sprague, Instructor in Botany, University of Missouri, Columbia, Mo.

Riley, Cassius M., Professor of Chemistry in Barnes Medical College and Barnes College of Pharmacy, St. Louis, Mo.

Robertson, Charles, Carlinville, Ill.

Ruppert, G. E., 5 W. 86th St., New York, N. Y.

Sale, Rev. Samuel, 4010 W. Bell St., St. Louis, Mo.

Schaller, Waldemar T., U. S. Geological Survey, Washington, D. C.

Scherf, C. Harry, 114 Marietta St., Burlington, Iowa.

Schmucker, Samuel Christian, Ph.D., Professor of Biology, Normal School, West Chester, Pa.

Seaman, Arthur Edmund, Professor of Geology and Mineralogy, Michigan College of Mines, Houghton, Mich.

Segerblom, Wilhelm, Professor of Chemistry, Phillips Exeter Academy, Exeter, N. H.

Shibley, George H., 53 Bliss Building, Washington, D. C.

Shimer, Hervey Woodburn, Instructor in Geology, Mass. Institute of Technology, Boston, Mass.

Shull, George Harrison, Assistant in Botany, University of Chicago, Chicago, Ill.

Six, William Lewis, Philippi, W. Va.

Smith, Alice Maude, M.D., 327 North G St., Tacoma, Wash.

Sprague, Robert J., Knox College, Galesburg, Ill.

Stearns, H. D., Associate Professor of Physics in Stanford University, Stanford University, Cal.

Stickney, Malcom Enos, Instructor in Botany, Denison University, Granville, Ohio.

Stookey, Lyman Brumbaugh, Ph.D., Pathological Institute, Wards Island, New York, N. Y.

Summa, Hugo, M.D., Professor of Medicine, St. Louis University, St. Louis, Mo.

Taylor, Edson Homer, Teacher of Mathematics, Eastern Illinois State Normal School, Charleston, Ill.

Thornton, William M., Professor of Applied Mathematics, University of Virginia, Charlottesville, Va.

Townley, Sidney Dean, International Latitude Observatory, Ukiah, Cal.

Transeau, E. N., 220 S. Ingalls St., Ann Arbor, Mich.

Tucker, George M., Ph.D., University of Missouri, Columbia, Mo.

Tutton, Charles H., 140 York Street, Buffalo, N. Y.

Wackenhuth, F. C., Jr., Technical Brewer, 57 Freeman St., Newark, N. J.

Wallace, Robert James, Yerkes Observatory, Williams Bay, Wis.

Walton, L. B., Professor of Biology, Kenyon College, Gambier, Ohio.

Weidman, Samuel, Geologist, Wisconsin State Geological and Natural History Survey, Madison, Wis.

Wetzel, Reinhard A., Supt. Science High School, Fargo, N. D.

Wilcox, Guy Maurice, Professor of Physics, Armour Institute, Chicago, Ill.

Willett, James R., 434 W. Jackson Blvd., Chicago, Ill.

Williams, Frank Blair, Ph.D., Assistant Professor Civil Engineering, Union College, Schenectady, N. Y.

Wilson, Delonza Tate, Case School of Applied Science, Cleveland, Ohio.

Wiseman, Carl Marshall, Optician, 301 W. Chestnut St., Louisville, Ky.

Woods, Carl Fred, Dartmouth College, Hanover, N. H.

Zeleny, Charles, University of Chicago, Chicago, Ill.

## SCIENTIFIC BOOKS.

*Ueber die Organization und Physiologie der Cyanophyceenzelle und die mitotische Teilung ihres Kernes.* Von E. G. Kohl. Jena, Gustav Fischer. 1903. Pp. 240, 10 plates. 20 mk.

This book, the result of several years of work on this interesting group of algæ on the part of Professor Kohl, will probably clear away definitely many of the clouds of doubt and contradiction over the structure of the cell of these plants. Professor Kohl applied his attention first to one species, *Tolypothrix latana,* until he had mastered the proper technique, and had acquired exact knowledge of its structure. Then he applied the same intensive study to *Anabœna catenula* and *Nostoc cœruleum,* afterwards testing his discoveries on a large series of the most diverse Cyanophyceæ.

Many points of structure, especially those bearing upon the shape and structure of the resting nucleus, as well as its behavior during division, were made the object of study in cells stained *in vivo,* as well as in cells fixed by various chemical reagents. The most important contribution to our knowledge is that in regard to the nucleus. The author confirms Bütschli's and Hegler's contention that the central body (Zentralkörper) is the nucleus. This organ occupies the center of the cell and runs out in numerous tapering branches into the surrounding cytoplasm, these processes often extending to the cell wall. As ordinary fixation methods cause their immediate retraction, they usually have been overlooked. The nucleus has no definitely staining delimiting membrane, nor does it contain a nucleolus. In it, and in it alone, are contained certain granules named by Kohl 'centralgranules (Zentralkörner) and thought by him to consist of reserve stuffs. The apparent occurrence of these granules in the cytoplasm is explained by their being often found in the processes of the nucleus. Similarly, granules belonging in the cytoplasm sometimes appear to be in the nucleus, when they are imbedded in cytoplasm between the bases of the nuclear processes. The central granules are identified by Kohl with Bütschli's red grains, Nadson's Chromatinkörner, etc., and with the Volutanskugeln of the bacteria.

The cytoplasm contains various inclusions, chief among which are the cyanophycin granules (protein crystalloids), fat drops and certain semi-fluid bodies in the heterocysts which are found to fill up the pits in the cell wall at the point of attachment to adjoining cells.

According to many authors, this blue-green cytoplasmic mantle between the nucleus and cell wall is the single, cylindrical chromatophore. Kohl, however, combats this idea and considers as chromatophores the very numerous minute, colored bodies about 0.6 $\mu$ in diameter scattered throughout the otherwise colorless cytoplasm. In their reaction towards stains they behave as do the chromatophores of higher plants. A study of the coloring matter of the cell shows that besides chlorophyll and phycocyanin, there is also always present carotin, the xanthophyll of many authors, which is never absent where chlorophyll is found, throughout the vegetable kingdom. It is the combination of these coloring matters in various proportions that makes possible the great variability of color of the different species, or even within the species of this group.

Instead of starch these algæ produce as carbohydrate the nearly related glycogen, storing it, apparently equally distributed, in the cytoplasm and not in granules.

The cell membrane consists of chitin with a very small amount of cellulose and pectin. In the heterocysts, however, a layer of cellulose is laid down when it (the heterocyst) begins to develop. In those genera with sheaths the filaments lie free in the sheath except the heterocysts, which are grown fast to it. Kohl sees in this the explanation of the function of these cells. They serve as points of resistance in the formation of hormogones, and in the branching of the filament. What the function can be in the forms without a sheath he does not clearly explain. They are evidently, however, not reserve cells, for they originate by the formation of stoppers for the pores through which alone the adjacent cells could furnish or receive reserve stuffs. They then build the cellulose wall and totally degenerate.

Here and there in the filament a single cell or several cells soften and degenerate, forming the points at which the filament breaks when it divides or produces hormogones. In the forms with false branching such degenerated cells are formed below the heterocysts and seem to help soften the sheath wall so as to enable the filament to turn out through the sheath when the resistance of the fast-grown heterocyst prevents its growing further in a straight line.

Normally the cells have no cell-sap vacuoles. They resemble meristematic cells in the size of the nucleus and density of the cytoplasm. Only in old or terminal cells and in the heterocysts do such vacuoles occur. The so-called gas vacuoles that Kohl mentions as occurring in some Cyanophyceæ have been proved definitely by Molisch and Brand, working independently, to be not of gas nature.

All cells are connected by a fine thread of plasm, which penetrates the center of the pore in the cell wall; even in the heterocysts where the pore is filled up the plasma thread remains, but it is unable to convey enough foodstuffs to keep the heterocyst plasma in good condition.

The nuclear division was made the object of especial study. By staining the living cells with methylene-blue Kohl was able to follow the process without subjecting himself to the criticism that his chromosomes were artefacts. The nucleus consists of a ground mass and a difficultly visible fine chromatin-bearing filament. This thickens itself and finally forms a spirem. This breaks up into usually six straight chromosomes which arrange themselves parallel to the long axis of the thread. They then begin to bow in somewhat, until they are much farther apart terminally than centrally. They then divide *crosswise* in the middle, *not lengthwise,* and collect at each end of the cell. At this point in the division a few achromatic fibers are visible, connecting the two masses of chromosomes, but no spindle in the proper sense is seen. The daughter chromosomes arrange themselves parallel, then form a spirem. As the chromosomes divide, the body of the nucleus which retains its distinctness from the cytoplasm begins to pinch in at the middle, and soon the separation of the two nuclei is complete. A cell wall separates the new cells at once.

The author also discusses the relationship of the Cyanophyceæ to the bacteria, holding that they are closely related and that the latter too probably have a nucleus similar to that described.

The book is, unfortunately, marred by an excessive number of typographical errors. The ten plates illustrating the book are finely executed and are very helpful to the understanding of the subject.

Ernest A. Bessey.

*Geology of Economic Non-metallic Minerals.* By Francis Miron, C. E.*

This little volume is published as one part of the 'Encyclopédie Scientifique des Aide-Mémoire,' issued under the direction of M. Léanté, member of the Institute of France. It is the fourth by the same author, the preceding volumes having dealt respectively with: (1) Mineral oils, (2) subterranean waters and (3) metallic minerals and mining. The general object is to furnish a series of brief hand-books describing the geological distribution, manner of occurrence and methods of procuring and utilizing of the substances treated of in each of the volumes. The pres-

* 'Gisements Mineraux; Stratigraphic et Composition,' par François Miron, Paris, Masson et Cie, pp. 157. (Part of 'Encyclopédie Scientifique des Aide-Mémoire.')

ent one deals with economic minerals strictly, exclusive of metallic ores, and in the main of precious and ornamental stones.

The plan of the work is good, and the geological element in it is valuable; but the treatment is very unequal, some portions being well and fully presented, and others but inadequately. The work bears no date, and takes no note of some important recent developments, *e. g.*, that of monazite and the related rare earths. Its chemical formulas, too, are not modern. As a whole, the book is of interest in its suggestion of what might be, if the author's ideas were carried out more fully and comprehensively, errors and omissions corrected, and the treatment brought up to date.

G. F. K.

## *SOCIETIES AND ACADEMIES.*

### ONONDAGA ACADEMY OF SCIENCE.

At the October meeting of the academy, held in the Syracuse high school building, Dr. T. C. Hopkins presented an illustrated paper on the glaciers of Switzerland and Austria. The paper was based on field studies in the Alps during the past summer. It illustrated many features of the Alpine glaciers such as the snow fields, aiguilles, crevasses, moraines, gorges and the marked recession of many of the glaciers in recent years.

At the November meeting of the academy, held in the historical society rooms there were three papers on biological subjects:

1. *Diseases of Cultivated Flowering Plants:* George T. Hargitt.

The diseases were classified, according to the function disturbed, into three classes:

(*a*) *Disturbed Photosynthesis.*—The rusts are one of the commonest diseases of plant life and in the carnations it is caused by the fungus *Uromyces caryophyllinus*, one of the most serious diseases of this plant. *Darluca filum*, usually occurring in connection with this rust, is commonly considered as parasitic on the rust, but investigations seem to show it rather to be parasitic on the carnation. Plants affected by both the rust and *Darluca* are in worse condition than those affected only by the rust. The disease 'white legs' of the aster results in dwarfing, malformation and final decay. It is caused by nematode worms of the genus *Heterodera* or perhaps *Aphenenchus*. Leaf spot diseases, common in a great many plants, are caused by a number of different fungi.

(*b*) *Disturbed Transpiration.*—The rusts also cause a disturbance of the transpiration, which is usually the more destructive, due to the unguarded evaporation of water through the ruptures in the epidermis caused by the liberation of the spores. In carnations a disease called stigmonose is caused by the punctures of insects.

(*c*) *Interference with the Supply or Absorption of Water.*—The most destructive disease of this type is the aster wilt or stem rot. The characteristic effect is a wilting and a yellowish color first seen on one side of the plant, usually in one of the lower leaves. It is caused by the growth of a *Fusarium* fungus in the large water-carrying vessels, which are thus gradually clogged up. A more elaborate paper on this subject by Mr. Hargitt appears in the report of the Nebraska State Horticultural Society for 1903.

2. *Some Features of the Development of Flowering Plants:* Dr. J. E. Kirkwood.

The paper embodies the results obtained from the study of the embryology of about fifteen species of the Cucurbitaceæ. In all the forms examined the ovary begins by the invagination of a lateral shoot and the organs of the flower appear in the following order: sepals, petals, staminodia (when present) and carpels. In the early stages of embryonic growth the endosperm plays an important part by digesting the nucleus and nourishing the embryo.

3. *Bithynia tentaculata:* Albert J. May.

The gastropod *Bithynia tentaculata* was introduced into the United States from Europe and has become very abundant in New York. It was first noticed in this country in 1879, when specimens were taken simultaneously at Oswego and in the Champlain canal near Troy.

They seem to multiply and spread very rapidly. They are now reported from points all along the Hudson River and the Erie Canal. They are abundant in the Genesee and Niagara Rivers.

It is quite noticeable that wherever *Bithynia* appears the native forms appear to thin out rapidly.

The species is herbivorous, feeding on algæ and other plants. They are oviparous. The female deposits her eggs on stones and aquatic plants in a mass of gelatinous material which is covered with a tough elastic membrane. The eggs are laid in numbers varying from 15 to 25, in bands of two or three rows.

The December meeting of the academy in the high school building was addressed by Dr. C. W. Hargitt, on the subject of recent activities of Mt. Vesuvius. It was illustrated by photographs made during the last summer and ten years ago. The speaker illustrated many features such as the lava streams, the ash cone, the crater, the partially excavated Pompeii, and many of the small volcanic cones and associated phenomena in the vicinity of Vesuvius.

T. C. Hopkins,
*Corresponding Secretary.*

### THE CLEMSON COLLEGE SCIENCE CLUB.

The Clemson College Science Club held its regular monthly meeting November 20, 1903. The first on the program was Mr. B. H. Rawl with a paper entitled 'Pasteurized Milk.' The speaker explained fully the objects desired to be accomplished in the pasteurization of milk. The differences between sterilization and pasteurization were pointed out. The speaker, while not minimizing the importance of pasteurization, emphasized the necessity of producing milk under sanitary conditions, thus preventing the entrance of harmful bacteria into the milk. This was considered more desirable than attempting to rid the milk of bacteria after their entrance by such processes as pasteurization, etc. Apparatus for pasteurizing in the home and on a commercial scale was described.

The next on the program was Dr. G. E. Nesom, whose subject was 'The Relation of Bovine Tuberculosis to Man.' This communication consisted largely of a selection of readings from a bulletin published by the author and papers published by Drs. Ravenal and Cary. The speaker referred to the distribution of tuberculous animals in the United States, the figures showing that Massachusetts contained the highest percentage. The number of tuberculous animals in the south and especially in South Carolina is relatively small. The speaker brought out the fact that there are no differences, morphological or otherwise, in the bacteria of human and bovine tuberculosis. The bacteria of bovine tuberculosis, however, are believed to be more virulent. Numerous experiments were cited to show the ability of bovine tuberculosis bacteria to cause the disease in man. The discovery and uses of tuberculin were pointed out. In view of the transmissibility of bovine tuberculosis to man, the speaker urged in conclusion the necessity of a thorough inspection of all animal products (meat and milk).

F. S. Shiver,
*Secretary.*

## DISCUSSION AND CORRESPONDENCE.

### CONVOCATION WEEK.

There are various objects that may be achieved by a meeting of a body like the American Association for the Advancement of Science.

1. It must give opportunities for making the acquaintance of or renewing acquaintance with men whom one likes to know.

2. It must give opportunities for discussion of scientific subjects with those competent to discuss them.

3. It must give opportunities for learning of new discoveries and theories in the field of science, from those who are competent to describe them.

4. It may open the road to the publication of papers submitted, in such a manner as to command general public attention.

5. It may concentrate the influence of men of science, and give their views that power with the general public that can only flow from acknowledged authority.

The three objects first named may be measurably achieved at the meetings of every scientific society of specialists. The two objects last named can not be. They can be prosecuted only by a society for the promotion of all science: hence they should be specially cultivated by the American Association for the

Advancement of Science, which is practically the only American organization of that character.

The way to get the public ear is to get it, as far as one can, at first hand. The door of the American Association for the Advancement of Science is wide open for the public to enter. It should be. Sectional discussions are at their best when there are enough listeners to stimulate the speaker to do his best. Scientific statements are at their best when plainness of speech is compelled by a miscellaneous audience of people educated, indeed, but differently educated.

Therefore, I think the meetings of the association should be held when and where they will attract the largest attendance, and sectional meetings or meetings of affiliated societies so arranged as to make it easy for members to pass from one room to another, and hear something upon many subjects.

The largest attendance, I believe, can be secured in July or August. Convocation week is not even a free week for all college and university teachers; to school teachers it is seldom free; to business and professional men, rarely, if ever. Simeon E. Baldwin.

The meetings of scientific societies seem to me to serve a real purpose in affording a pleasant opportunity for the personal acquaintance of scientific men, but I can not think that they are otherwise a great factor in the progress of science. It seems to me to be highly expedient that all the affiliated societies should meet at the same time and place, but I do not think that this meeting should be coincident with any other great distracting event, because attention will thereby be diverted from the main object of the meeting, and because no city can comfortably distend its possibility of accommodation to include excessive numbers. A general meeting once a year ought to be enough, in view of the many local meetings, the restricted means of many of the members, and the great extent of the country. Both midwinter and midsummer are likely to be unpleasant for travel in America, and, therefore, early autumn seems to me the time when the largest number of members could be assembled, unless, indeed, the colleges could be induced to unite upon a common time for a spring vacation. Another argument against midwinter, but in favor of the spring or early autumn, lies in the fact that after April the results of a winter's laboratory work are usually in a more presentable condition than they were in the preceding December, while the following December often finds the papers already in print. This is, however, a secondary consideration, since the main office of the meeting is personal, rather than scientific.

Theodore W. Richards.

Before very much can be done in the way of bringing together men working in different scientific fields, it will be necessary to improve the meetings of the sections. Relatively few men go to the meetings of the American Association because they feel that they will lose something by staying away. The attendance is very largely the result of a sense of duty. One reason for this has been a mistaken idea on the part of the officers of the sections as to the real objects of the meeting. Each presiding officer has felt that the success of the meeting is measured by the number of papers presented before his section and he has done his best to overload the program. In order to finish on time, it has been necessary to ask that discussion of the papers be omitted or be made as brief as possible. To the people who do not read papers, the morning session becomes a trial of endurance with no enlivening features. After a few years of this, people lose all tendency to discuss and it is then necessary for the officers to overload the program.

In the afternoon things are not much better. The local members of the section are both hospitable and energetic. They arrange one or more excursions for each afternoon. People hurry through their lunch and walk round in crowds for hours, not understanding a quarter of what they see, and getting back to their hotels in a state bordering on collapse. It is all well meant, but it is a case of misdirected energy.

The usefulness of the meetings lies in the

personal element, in making men acquainted, and in giving them a chance to discuss things and to exchange ideas in a way that can not be done by letter. The mere reading of papers is a waste of time. Tagging round as one of a crowd on an afternoon excursion is a waste of energy.

The ideal meeting, as I see it, is very different. In the morning we should have short papers, if possible of general interest, and each paper should give rise to an animated discussion taken part in by as many people as possible. In the afternoon men should get together in small groups to talk over matters in a more careful way. There is no objection to one excursion, but that is enough. The evenings would then be left free for general social gatherings which certainly should not be confined to the single sections.

We get a little of all this now, but relatively little and that rather under protest. While there will be some differences of opinion as to what constitutes a successful meeting, it is certain that the meetings can be made of more value than they now are; and that the way to do it is for each member to decide for himself what he wants and then to work for it.

Wilder D. Bancroft.

To the Editor of Science: The desirability of so organizing and correlating the scientific activities of our country as to secure the largest results both in progress and influence can hardly be open to serious question. Just how to secure these ends is, of course, a difficult problem. We have some three types of scientific societies, two of which only are of immediate concern in the problem under consideration, namely, the more specialized or technical societies, such as the Society of Anatomists, Society of Bacteriologists, Society of Zoologists, etc., and those of broader or more general scope, of which the American Association for the Advancement of Science is representative. Of the other type, represented by the National Academy of Sciences, it is unnecessary to speak, since the exclusiveness of its membership as well as the fact of its independence of meeting as to both time and place do not bring it into direct relation with the more serious aspects involved in the correlation of the others as to times, places, programs, etc.

While in the first attempt of the conjunction of these technical and affiliated societies with the American Association at Washington a year ago there may not have been entire harmony, nor the realization of that adjustment of programs and hours of meeting which was hoped for, it may be doubted whether, as a whole, there has been a more enthusiastic meeting of scientific men from the entire country, with larger opportunity for congenial conference and acquaintance, in the history of such gatherings in our country.

While there must of necessity exist many of the strictly technical class of associations, and with increased specialization they are likely to become more rather than fewer, there still remains the no less imperative necessity for such organization of scientific effort as will make possible concentrated and consistent and direct sentiment for the enactment of needed measures of influence for whatever emergency may call for such. While this may have been measurably afforded by the Society of Naturalists, it was necessarily limited to a small class of scientists and to a limited range of territory. And though western sections, or *many* sections, be organized, there can never be anything like an ideal organization for aggressive work of a generally representative character through those sources. It may well be doubted, indeed, whether the day and the demand for the existence of the Society of Naturalists have not passed away, and whether a new demand under new conditions has not arisen which ought to be recognized and welcomed.

It is my firm conviction that there are in the American Association and in the technical societies conditions and factors which, properly correlated and adjusted, afford the most hopeful outlook for organized scientific progress within the present generation. And with the submergence of personal ambitions and aspirations and an earnest effort to secure the larger results of broad and well-organized effort an era of advance unparalleled may be entered upon.

Chas. W. Hargitt

To the Editor of Science: I cordially sympathize in your desire to have the scientific men of the country come together in the sessions of the American Association for the Advancement of Science. I learned to love the society in the ante-bellum days, when the greatest scientific minds of the whole country made it their business to attend and to participate in the discussions. Every year new members joined us, and we used to say, Mr. X was one of the number who came to us at the Providence or Montreal meeting, and has been a constant attendant ever since. It was more convenient then for the association to meet in the summer—and perhaps one may be excused for believing the warm season to be the best for these gatherings, because of the great success of those early meetings. I like your suggestion of having two meetings annually, one in the summer and the other in the winter, and I should say the localities might be chosen to fit the season—the far south in the winter, and the far north in the summer; or there might be a contrast between the east and the west.

With provisions for two meetings, some of the affiliated societies could arrange to meet by themselves, say in the winter, and in the summer to throw all their energies into their sections. It would be an important point gained if more interest was taken in the sections of the general association at one of the meetings.

Publication holds the first place in the thoughts of many. The question arises, Shall I present my subject before the section or before my special society; and the conclusion reached is usually in favor of the latter, because the paper may be published. If one has something important to present he wishes to have it printed. Of late years the American Association for the Advancement of Science has printed only the presidential addresses, and, therefore, the tendency is to slight the sections. If there were two annual meetings there could be two volumes printed, with some of the more important papers.

Then there is no opportunity for amateurs or new recruits to be represented in type unless there be some provision for the printing of papers. Perhaps I overlook the great service Science is doing for us, which prints some of the papers that do not appear in the *Proceedings*.

Section E has instructed its committee to arrange for a summer meeting this year. All will be interested to see the outcome of this move. The meeting will probably be held at St. Louis, and thus two questions will be answered by the results. Can there be an enthusiastic meeting of a single section in the summer, and can the section hold the attention of its members in the midst of the distractions of a world's fair? C. H. Hitchcock.

## SPECIAL ARTICLES.

### THE TOURMALINE LOCALITIES OF SOUTHERN CALIFORNIA.

The tourmaline deposits of southern California have attracted much attention recently, owing to the development of these mines for their gem stones. A recent discovery of lilac-colored spodumene has added considerably to the interest. For the purpose of acquiring a knowledge of the character of these tourmaline deposits and of studying the associated minerals, the writer spent several weeks among these mines last summer and collected some very interesting material. In this note is given a brief account of the principal localities and of the minerals that have been found there. The writer intends to make a complete study of this remarkable field, and especially of the minerals occurring in it, many of which are of more than ordinary interest. Some of the work has already been completed* and the remainder is well under way.

The gem tourmalines occur in rather large quantities, but are inferior to the Maine tourmalines both in color and in the brilliancy of the cut gems. The localities at which they have been found are comprised in an area less than thirty miles across in northern west-central San Diego County, extending into Riverside County and including portions of Smith's Mountain and the western part of the

* 'Spodumene from San Diego Co., California,' by W. T. Schaller, Bull. Dept. Geol. Univ. of Cal., Vol. 3, No. 13.

San Jacinto Mountains. The places where working mines are located are not many and may be grouped under four heads—those at (1) Pala, (2) Mesa Grande and (3) Oak Grove in San Diego County, and those at (4) Cuahuila in Riverside County.

1. The mines at Pala consist of the famous lepidolite mine from which the well-known specimens of rubellite come and the spodumene mine, about a mile away, which has already been described by the writer. The immense deposits of lithia minerals at the lepidolite mine occur in a pegmatite dike striking across a large body of diorite and dipping towards the west at a low angle. This dike is about a mile long and has a thickness of from twenty to eighty feet.

The pegmatite, in which large bodies of lepidolite and other lithia minerals occur, consists of a coarse muscovite-granite with garnets and black tourmalines. There are at least four of these large bodies of lepidolite exposed, only one of which is at present being mined. A conservative estimate of the size of this body of lepidolite, now in sight, would be $200 \times 100 \times 25$ feet. In some parts radiated groups of rubellite occur, and near the northern end of the body quartz and feldspar become rather abundant and the deposit seems to grade into the normal muscovite-pegmatite.

The pink clay—so often associated with gem tourmalines—occurring here has been determined to be halloysite. A large deposit of pure amblygonite, showing broad cleavage faces, has been uncovered. Numerous well-terminated green tourmalines, with complex combinations, have also been found, as well as several pounds of native bismuth and its oxidation products, bismuthinite and bismutosphærite. The bismutosphærite occurs in grayish-black masses and also as a yellow powder. A qualitative test showed the presence of carbonic acid and the absence of water. Doubly terminated quartz crystals are not uncommon. The list of minerals from this mine so far identified is lepidolite, tourmaline (black, green, pink), amblygonite, orthoclase, muscovite, quartz, kaolinite, halloysite, garnet, plagioclase feldspar, bismuth, bismuthinite and bismutosphærite.

At the spodumene mine the following minerals have been identified: tourmaline (black, pink, blue, blue-green), spodumene, lepidolite, beryl (pink), quartz, muscovite and orthoclase.

Very pale green, colorless and lilac-colored spodumene has been found in the mountains a few miles east of the mine.

2. The Mesa Grande district is the most important one for tourmalines. Two mines, only one of which was accessible to the writer, are situated here, both being located on the same series of pegmatite dikes. The country rock in which these muscovite-granite dikes occur is a diorite.

In the mine visited three such dikes are being followed, only one of which is at all rich in tourmalines. The dikes, only a few feet in thickness, dip southwest at an angle of 45° and are usually not much decomposed. Sometimes, however, the granite has become altered to a red clay and then this is carefully searched for loose tourmalines. Lepidolite is not abundant and is usually rather coarse. Muscovite, with a lepidolite border, is of frequent occurrence. Several fine crystals of lepidolite have been found in this mine, one complete crystal measuring 10 mm. across the base and having a height of 6 mm.

The tourmalines are mostly pale pink, though some red ones of good color, as well as green ones, have been found. Several good achroites have also been found, one in the possession of the writer measuring 35 mm. in length and 14 mm. in thickness. Besides the minerals mentioned above, quartz and orthoclase in large, complete crystals are found here. Garnet and beryl occur in the immediate vicinity.

3. The geology of the Oak Grove mine is similar to that of the other localities. Some of the cut tourmalines from this mine are exceedingly brilliant. Several fine yellow tourmalines have been obtained here. The minerals occurring at this mine are the same as those found at the Mesa Grande mine.

4. The Cuahuila locality is similar to the others, and the list of minerals found here includes tourmaline (pink, green, blue, blue-green, smoky, colorless, yellow and black), spodumene (the amethystine variety), beryl

(transparent pink crystals, one measuring 110 $\times$ 75 $\times$ 65 mm. and weighing 850 grams), lepidolite, pink andalusite, muscovite, orthoclase and quartz.

The field is certainly a very interesting one and is well worth further study. Many of the minerals occur in good crystals having rich combinations of forms, and the color of some of the specimens suggests interesting chemical possibilities. It is probable that with further exploration the list of minerals will be considerably increased.

Waldemar T. Schaller.
U. S. Geological Survey.

### A NOTE ON RHIZOCTONIA.

The bean crop in the vicinity of St. Louis was severely injured this year in many instances by *Rhizoctonia,* sp. which not only attacked the stems and larger roots of the plants, but also produced brown, sunken areas on the surface of the pods, penetrating the latter and discoloring the seeds. An examination of a number of seeds whose surface was discolored disclosed the fact that the mycelium of the fungus had established itself in the seed coat and in many instances had formed minute sclerotia there without rotting the seed or even penetrating the cotyledons. Pure cultures of *Rhizoctonia* were easily obtained from a number of mature discolored beans which had been carefully removed from diseased pods. The presence of the fungus does not prevent the germination of the seed, as was proved by a test. From this it follows that a very common means of disseminating *Rhizoctonia* on the bean is through diseased seed, and that seedsmen should be careful not to send out discolored beans.

G. G. Hedgcock.
Mississippi Valley Laboratory,
St. Louis, Mo.

## *QUOTATIONS.*

### THE CARNEGIE INSTITUTION.

It is worth pointing out that the almost inevitable outcome of the present policy will be a centralization of a very objectionable kind. If the activities of the Carnegie Institution were to be wholly confined to aiding individuals here and there, that end could have been best attained by dividing the endowment among the leading institutions of learning, under such restrictions as might have been necessary. Every such organization could then have determined for itself, better than a central one at Washington, what the needs of its professors were, and what might be the importance of their work. It could have established branch stations at least as well as can the Washington institution. It could have sought out the exceptional man with even better chances of finding him, because its field of knowledge would have been wider than that of any central authority. Each could, for itself, have selected the best research-assistant to be found.

Now, instead of this result, we actually have a central authority passing judgment upon the relative importance of the work being done at all the institutions of learning from which applications may come, and aiding them, or refusing aid, according to their judgment. One very probable outcome of this has not been sufficiently considered. It must tend, to a greater or less extent, to diminish the spirit of individual effort, just as gifts are apt to do in many other walks of life. This effect will be intensified by a very obvious and reasonable provision announced by the institution as governing its action. It does not propose to undertake anything that is being well done by other agencies. It would, of course, be superfluous to assist a professor in cases where the patrons of his own institution could be induced to do so. The latter will naturally not be very liberal in giving their funds if the Carnegie Institution can be successfully appealed to. If the appeal is a failure, that failure will be a reason against the project in the mind of a possible donor. The dilemma will be that of Omar: If the Carnegie Institution can be induced to support your work, our aid is not needed; if it can not be so induced, the object is not worthy of our support. Of course, it is not claimed that this consideration will be universal, or will be operative immediately and in all cases. But to suppose that it will never be operative in any degree is contrary to every principle of human nature.

The progress of knowledge has brought us to a point where our nation needs the services of a body of men who shall be engaged in work of a distinctively different type from that carried on in our traditional institutions of learning, a work which belongs peculiarly to the present and future, because it was not possible in the past. Looking at our intellectual history, we have grown from the high school of our revolutionary ancestors to the college; from the college stage we have grown to the university stage. Now we have grown to a point where we need something beyond the university. We want an institution at the city of Washington at which shall be organized a system of research on that higher plane and larger scale which the progress of experimental science and observational knowledge now requires. Such a work would be at a disadvantage in being connected with any existing university for the same reason that the college was at a disadvantage when grafted on the preparatory school, and for the same reason that our universities are now at a disadvantage in being grafted upon the colleges. What we want might be appropriately called the National Research University. If the Carnegie Institution is not to grow into anything of this kind, is there not among us some possessor of great wealth ready to become its founder?—Professor Simon Newcomb in *The North American Review*.

### EXPERIMENTS IN FLYING.

In October last we resumed the trials on the Kill Devil practice ground with the machine which we had used during the previous year, and succeeded in making flights in which the operator remained in the air over a minute, at one time being suspended 1 minute 11.80 seconds. While carrying on the experiments, our power machine was under construction. In dimensions it measures a little over 40 feet from tip to tip of the wings, of which there are a pair. Its length fore and aft, to use a nautical phrase, is about 20 feet, and the weight, including that of the operator, as well as the engine and other machinery, is slightly over 700 pounds. We designed the machine to be driven by a pair of aerial screw propellers placed just behind the main wings. One of the propellers was set to revolve vertically and intended to give a forward motion, while the other underneath the machine and revolving horizontally, was to assist in sustaining it in the air.

We decided to use a gasoline motor for power, and constructed one of the 4-cycle type, which, revolving at a speed of 1,200 revolutions a minute, would develop 16 brake horse-power. It was provided with cylinders of 4-inch diameter and having a 4-inch stroke and intended to consume between 9 and 10 pounds of gasoline an hour. The weight of the engine, including the wheel, is 152 pounds.

We had calculated that this amount of mechanical power would be sufficient to maintain the machine in the air, as well as to propel it, the calculations being the result of gliding experiments, which showed that when the wind was blowing at a rate of 18 miles an hour the power consumed in operation was equal to 1.5 horse-power, while with a wind of 25 miles an hour it represented 2 horse-power, being capable of sustaining a weight of 160 pounds per horse-power at the 18-mile rate.

After the motor device was completed, two flights were made by my brother and two by myself on December 17 last. The apparatus had been placed on a single rail track, built on the level, the track supporting it at a height of eight inches from the ground. It was moved along the rail by the motor, and after running about 40 feet ascended into the air. The first flight covered but a short distance. Upon each successive attempt, however, the distance was increased, until at the last trial the machine flew a distance of a little over a half mile through the air by actual measurement. We decided that the flight ended here, because the operator touched a slight hummock of sand by turning the rudder too far in attempting to go nearer to the surface. The experiments, however, showed that it possessed sufficient power to remain suspended longer if desired. According to the time taken of each flight a speed varying from 30 to 35 miles an hour was attained in the air.

We should have postponed these trials until the coming season, but for the fact that we wished to satisfy ourselves whether the ma-

chine had sufficient power to fly, sufficient strength to withstand the shock of landing, sufficient capacity to control. Winter had already set in when the last trials were made, but these facts were definitely established, and we know that the age of the flying machine has come at last.—Wilbur Wright in *The Independent*.

### *NOTES ON INORGANIC CHEMISTRY.*

Two papers have recently appeared in this country which, while not directly concerned with inorganic chemistry, have an important bearing on it. The first of these is a 'New Method for Determining Compressibility,' by Theodore William Richards and Wilfred Newsome Stull, and is published by the Carnegie Institution. Very little work has been previously done on the compressibility of inorganic substances, although such investigations are calculated to throw light upon the subjects of chemical affinity and cohesion. New methods have been devised by which the compressibility of nearly all solids and liquids can be determined up to 600 atmospheres or more. By means of these methods Richards and Stull have determined the compressibility at 20° of iodin, bromin, carbon tetrachlorid, chloroform, bromoform, water, phosphorus and mercury, while that of chlorin was estimated by extrapolation. Bromin is much more compressible than iodin, and it is probable that chlorin is still more compressible, being rather more than twice as compressible as water. Phosphorus is hardly half as compressible as water, while mercury was the least compressible substance measured, having a value less than ten per cent. that of water. In every case the compressibility decreases with increasing pressure. The authors suggest the use of the term *megabar* to indicate the pressure of a megadyne on a square centimeter, giving an absolute standard instead of the unscientific unit of an atmosphere. The value of a megabar is 75.015 centimeters of mercury or 98.703 per cent. of an 'atmosphere.' This the authors point out is more nearly the average pressure at the laboratories of the world than the arbitrary 'atmosphere' usually taken.

The second paper is on 'The Electrical Conductivity of Aqueous Solutions at High Temperatures,' by Arthur A. Noyes and William D. Coolidge. This is the first contribution from the recently established research laboratory of physical chemistry of the Massachusetts Institute of Technology, and concerns the description of the apparatus used and the results with sodium and potassium chlorid up to 306°. Great difficulty was encountered in devising a suitable conductivity cell which should fulfil the other necessary conditions and be capable of withstanding the great pressures at high temperatures. The cell finally found satisfactory was a platinum-lined soft crucible steel cell, with gold wire packing and quartz insulation. In the experiments with sodium and potassium chlorids it was found that the degree of dissociation decreases with the temperature. With tenth-normal solution of sodium chlorid this decrease is very rapid, from about 83 per cent. at 18°, to 60 per cent. at 306°, and indicates that the degree of dissociation is very small at the neighborhood of the critical temperature (about 360°). The conductivity of the vapor over a tenth-normal solution of potassium chlorid at 306° was too small to be observed with the apparatus, and is at all events exceedingly small. The investigations with this cell are being continued and it is hoped to extend the observations up to the critical temperature.

To the 'Quarterly Statement of the Palestine Exploration Fund' a paper is contributed by William Ackroyd on a principal cause of the saltness of the Dead Sea. After showing the insufficiency of the soil and rocks to furnish more than a fraction of the salt present, and that the theory that its saltness is due to its being a former arm of the Red Sea, which has gradually become concentrated, is not substantiated by facts, he claims that the most important cause is the atmospheric transportation of salt from the Mediterranean. As in other localities, the rain water would be charged with salt to a degree which varies in a direct manner with the velocity of the winds coming from the sea. This view is confirmed by the fact that the ratio of chlorin to bromin is approximately the same as that for these two elements in the Mediterranean.

It has been generally accepted that Moissan prepared diamonds synthetically by chilling an iron rich in carbon, the supposition being that in the interior of the mass of iron, solidified on the exterior, the pressure on solidification must be intense, and that under these conditions the carbon crystallized in the form of the diamond. This position is very strongly attacked by C. Combes in the *Moniteur Scientifique.* In his paper he argues that Goeppert and Friedel have found plant remains in diamonds, showing that the crystals must have been formed at a temperature below at least 772°. At the temperature of fused cast iron the diamond is converted into graphite. The diamonds supposed to have been formed by Moissan were doubly refracting, and hence not diamonds. Moissan's analyses of his crystals were unsatisfactory for diamonds. Finally Friedel has proved that such a mass of iron as was used by Moissan really contracts on cooling instead of expanding, and hence the supposed pressure was not present. Thus it appears to Combes impossible that Moissan has prepared diamonds synthetically. It is, however, possible that Hannay was more successful in this respect. J. L. H.

## *RECENT ZOOPALEONTOLOGY.*

### THE SAUROPODA.

Two memoirs have recently appeared on this group which greatly extend our knowledge, from the Carnegie and the Field Columbian Museums.

'Osteology of Haplocanthosaurus.'* This memoir by Mr. J. B. Hatcher is devoted to a new sauropod which is decidedly more primitive than any of the American Sauropoda hitherto discovered. In an exhaustive memoir illustrated with six plates the author describes it in detail. The principal new points are the following: The spines of all the cervical and dorsal vertebræ are single or simple, as in the carnivorous dinosaurs, instead of double, as in *Diplodocus, Morosaurus* and *Brontosaurus.* There are apparently fourteen dorsal vertebræ instead of ten as in the above-named forms, and from thirteen to fifteen cervicals; five sacrals and about forty caudals. The locality is the classic one of Cañon City, from which Marsh secured his type of *Diplodocus* about 150 feet above the summit of the red Triassic sandstones; the author believes it to be a lower horizon, of greater age than the Como Bluffs. As regards proportions, the thoracic region is believed to be proportionately longer than in the other dinosaurs. The limbs are elevated, and *Haplocanthosaurus* appears to have been an essentially quadrupedal type.

As regards general questions, the author considers the Dinosauria as a subclass. He adheres to the use of the term Sauropoda in preference to Opisthocœlia Owen or Cetiosauria Seeley. In this connection it may be pointed out that while Owen defined the Opisthocœlia as the suborder Crocodilia in 1859, he recognized them as Dinosauria in 1875. *Haplocanthosaurus* is placed in the family Morosauridæ, which is considered the most primitive family of Sauropoda. An especially interesting point is its resemblance to a type recently described from South America.

A very valuable feature of the memoir is the discussion of the age of the *Atlantosaurus* beds and of the geological section at Cañon City. The author shows that Cope's *Camarasaurus* skeleton was probably found 350 feet higher than *Haplocanthosaurus.* The conclusion is that the beds are chiefly of Upper Jurassic age, but in their uppermost members they may represent a portion at least of the Cretaceous.

'Structure and Relationships of Opisthocœlian Dinosaurs.'* The skeleton on which

*'Osteology of Haplocanthosaurus with Description of a New Species, and Remarks on the Probable Habits of the Sauropoda and the Age and Origin of the Atlantosaurus Beds,' by J. B. Hatcher, *Memoirs Carnegie Museum,* Volume II., No. 1, November, 1903. There are a few points requiring revision: The sacral ribs are described as 'parapophyses,' which a reference to the Permian ancestors of the dinosaurs will probably show to be incorrect. The theory that the Sauropoda were aquatic reptiles is through a misunderstanding attributed to Osborn.

*'Structure and Relationships of Opisthocœlian Dinosaurs, Part I., Apatosaurus Marsh,' by Elmer S. Riggs, A.M., Publ. Field Columbian Museum 82, Geol. Ser., Vol. II., No. 4, August, 1903.

Dr. E. S. Riggs bases this interesting memoir was found in the Grand River Valley, near Fruita, Colorado, in 1900. As illustrating the enormous labor connected with the preparation of such a specimen it may be mentioned that three skilled men were employed for more than eighteen months in mounting it.

The author adopts the term Opisthocœlia as having priority over either Cetiosauria or Sauropoda. Of still greater novelty is his identification of *Brontosaurus* with *Apatasaurus,* the type of which is that of a young animal differing from the subsequently described *Brontosaurus* in juvenile characters only.

The material includes the last cervical vertebra and the entire dorsal, sacral and caudal series as far back as the twenty-fourth caudal. We thus for the first time come into possession of the exact characters of the dorsals and of the full series of anterior caudals. These are very accurately figured and described by the author. The formula, like that of *Diplodocus* and *Morosaurus,* is, dorsals, 10, sacrals, 5, caudals, 24 +. The writer shows that Marsh placed too many vertebræ in the back in his restoration, while Osborn also erred in placing too many in the anterior portion of the tail.

The morphology of the sacral region of the Opisthocœlia in general is very accurately described, the only error being in the diagrammatic representation of the rib of the caudo-sacral, which should be like that of the primary sacrals and unlike that of the dorso-sacral as shown by reference to the Permian ancestors of the Dinosaurs. The author's theory (p. 185) of the early formation of the sacral vertebræ is also probably incorrect, because the primitive Diaptosauria (*Palæohatteria*) show very early a marked separation of the anterior sacral ribs from the posterior dorsal ribs.

The restoration of *Brontosaurus* is by far the most correct we have ever had. It illustrates especially the extreme shortness of the back and the marked elevation of the sacral spines.

H. F. O.

## THE MILWAUKEE MUSEUM.

The Report of the Board of Trustees of the Public Museum of the city of Milwaukee may well be read in conjunction with Mr. Bather's article in *Popular Science Monthly* on 'The Functions of Museums,' as in it the custodian explains what has been done and what, with proper facilities, may be done for the public and for students. Mr. Ward's desire to give a proper representation of the animals of Wisconsin and of North America, before 'dabbling in foreign specimens' is a step in the right direction; the Milwaukee Museum is one of our larger municipal museums and yet much smaller institutions waste much time and effort in the endeavor to duplicate the work of the large museums, the result being a small ill-balanced display of heterogeneous objects with nothing properly represented.

Few realize how extensive is the fauna and flora of any given locality and how interesting and instructive is a properly arranged and well-labeled local collection. The importance and efficiency of a museum does not depend merely upon its size, but upon the manner in which its collections are cared for and utilized. Mr. Ward shows great courage in discussing the question of gifts to museums, and treats the matter much as did Mr. Bather. In the earlier stages of growth of a museum collections are often accepted with the proviso that they are to be kept by themselves, and later on these gifts prove so many millstones around the neck of the institution, seriously hampering the progress of the museum. The way out of the difficulty is pointed out by both Mr. Ward and Mr. Bather; either let the gift be confined to desirable specimens or exhibits that may form part of an orderly whole, or let them be declined. Those who really have the good of a museum, or for that matter, other institutions at heart, will appreciate and accept the proviso and contribute to its growth and progress.

The Milwaukee Museum has added to its exhibition series cases containing the birds of the region about Milwaukee and a case comprising the birds found at various periods of the year, the contents of this being changed according to the season; also a number of

living animals of the lower forms, and an exhibit of such wild flowers as may be in bloom.

The Nunnemacher collection of arms has been extended and it is noted that this probably contains the best series of firearms exhibited in any museum in the country.

There is the usual plea for more room and it is to be hoped that this plea may meet with a favorable response and the fine building extended to meet the exigencies of the case.

L.

## *THE SMITHSONIAN INSTITUTION.*

We reproduce from the Washington papers the accounts of the meeting of the regents of the Smithsonian Institution, held in Washington on January 27, which it is understood are given out by the secretary. As an adjourned meeting was held in the evening, for the first time in recent years at least, it may be assumed that the general policy and administration of the institution were under discussion.

The annual meeting of the board of regents of the Smithsonian Institution was held at the institution at ten o'clock on the morning of January 27. Of the members of the board those present were: Mr. Chief Justice Fuller, the chancellor of the institution, who presided; Senator S. M. Cullom, Senator O. H. Platt, Senator F. M. Cockrell, Representative R. R. Hitt, Representative Robert Adams, Jr., Representative Hugh A. Dinsmore, ex-Senator John B. Henderson, Dr. A. Graham Bell, Dr. James B. Angell, ex-Secretary of State Richard Olney and the secretary of the institution, Dr. S. P. Langley. Senator William P. Frye, president *pro tempore* of the Senate; Judge George Gray and Dr. Andrew D. White were unable to be present. It was announced that Representatives Hitt, Adams and Dinsmore had been reappointed regents on the part of the House for a term of two years, and that Mr. John B. Henderson and Professor A. Graham Bell had been elected regents from the District of Columbia for a period of six years.

The secretary presented his annual report reviewing the work of the year ending June 30, 1903. The total permanent fund now stands at $937,000, deposited in the treasury. Certain railroad bonds forming a part of the Hodgkins fund make the total fund of the institution about $1,000,000.

The institution in addition was charged with the disbursement of congressional appropriations for the United States National Museum, the Bureau of American Ethnology, the international exchanges, the Astrophysical Observatory and the National Zoological Park, amounting in all to $472,400.

Under the Hodgkins fund a memoir has been issued by Dr. Barus, entitled 'The Structure of the Nucleus,' and grants have been made to Professor M. W. Travers, of University College, London, for researches 'on the attainment of very low temperatures'; to Dr. Victor Schumann, of Leipsic, for work on vacuum spectroscopy, and to Professor E. W. Scripture, of Yale University, for the construction of a 'vowel machine.'

The subscription to the Smithsonian table at the Naples Zoological Station has been renewed. During the year this table was occupied by eight American biologists, all of whom conducted special researches of value.

In the series of 'Contributions to Knowledge' two valuable publications have been issued, those of Dr. Barus and Dr. Schumann, while a memoir by Dr. Frederick W. True, entitled 'The Whalebone Whales of the Western North Atlantic, compared with those occurring in European Waters, with some Observations on the Species of the North Pacific,' and a work by Professor N. S. Shaler, of Harvard University, entitled 'A Comparison of the Features of the Earth and the Moon,' are in course of publication. A number of papers have been issued in the series of 'Miscellaneous Collections,' and a work by the late Dr. G. Brown Goode, 'What Has been Done in America for Science,' is now being prepared for the press.

The usual reports have been issued and greatly sought after. The library has received valuable additions from Gen. John Watts De Peyster, in Napoleonana, and on gypsies. The museum library has received two important gifts, being the E. A. Schwartz collection of books on American coleoptera, and the W. H. Dall collection of books on recent and fossil mollusks.

The institution has taken over for America the work of the International Catalogue of Scientific Literature.

At its last session Congress authorized the construction of a fireproof building for the use of the National Museum, at a cost not to exceed $3,500,000. The plans for this structure are now practically finished, and borings for the foundation have been made. The actual work will begin in warm weather, though it will probably be three or four years before the building is completed.

Two hundred and thirty-six thousand specimens

were received, making the present total over 5,650,000, and about 33,000 objects were distributed to educational establishments. Among the most interesting accessions were those illustrating the native arts and industries of Sumatra and the Straits Settlements, collected by D. W. L. Abbott; a series of models of United States war vessels and of land and naval ordnance; and some relics of General and Mrs. Grant, of much intrinsic and historic interest.

After paying a tribute to the late Major John W. Powell, the first director of the Bureau of American Ethnology, the report describes the continuance of the work, under the direction of its new chief, Professor W. H. Holmes. Systematic field work has been successfully prosecuted in many states and territories, and in Santo Domingo and Porto Rico. The preparation of the dictionary of Indian tribes has been taken up with renewed vigor.

The number of correspondents and beneficiaries of the international exchange service is now over 44,000.

In the National Zoological Park a new elephant house has been built. In view of the increased number of buildings in the park, each one of which has now to be provided with its own heating apparatus, it is recommended that a special building in the park, lying within a reasonable radius, be erected for a central heating plant. Much interest has been shown in the park by our officers abroad, of whom there may be specially mentioned Dr. F. W. Goding, United States consul at Newcastle, New South Wales, who has sent more than 140 specimens from that region.

The astrophysical observatory has been enriched by a large horizontal telescope, to be used for studies of special portions of the solar radiation. Results of uncommon interest have been reached in the bolographic work, and it has been shown that the earth's atmosphere has been more opaque than usual within the present calendar year, so as to reduce the direct radiation of the sun at the earth's surface by about ten per cent. throughout the whole visible spectrum, and by more than double this amount in the blue and violet portions of the spectrum. This alteration of the transparency of the air has not been confined to the region of Washington. A new determination of the temperature of the sun, based on the distribution of the solar radiation in the spectrum, has yielded a result of 5,920 degrees of the centigrade scale above absolute zero. A horizontal reflecting telescope of 140-foot focus and 20-inch aperture, and a coelostat of improved construction, to furnish at all times a 20-inch horizontal northerly directed solar beam, has been provided. The most interesting part of the results consists in showing a notable variation of atmospheric transparency which is likely to have affected climate and the growth of vegetation over a considerable part of the earth's surface, and in the studies relating to the solar constant, so that there seems renewed promise of progress toward the goal 'for telling by such means those remoter changes of weather which affect harvests,' which is one of the aims had in view in the foundation of the observatory.

The question of vandalism and exploitation for commercial purposes of archeological sites having been brought to the attention of the board, the following resolution was adopted: *Resolved*, that the passage by congress of an act for the preservation of archeological objects on the public domain is in the national interest, and would aid in promoting the science of archeology and ethnology; and that the secretary be requested to present to the congress the draft of a bill having this end in view.

Dr. Alexander Graham Bell, who was a committee of one on behalf of the regents charged with the duty of bringing the remains of Smithson to the United States, submitted a report. Dr. Bell reached Genoa on December 25, and on the 31st of that month the remains of Smithson were exhumed in the presence of the American consul and six other witnesses. He submitted a certificate of the United States consul, Mr. William Henry Bishop, describing the exhumation. Mrs. Bell then placed within the coffin a wreath of leaves from the grave of Smithson and the United States consul placed an American flag as a covering for the casket. Brief addresses were made immediately before the removal of the remains from the mortuary chapel by the United States consul and Dr. Bell and Mr. Noel Lees on behalf of the British burial ground fund committee.

The regents, after the report, voted that there be placed upon the record an expression of their profound appreciation of the services of Dr. Bell in going to Genoa and returning with the remains of James Smithson that they might find a resting place in the grounds of the institution he so nobly founded 'for the increase and diffusion of knowledge among men.'

A committee was appointed to choose the spot in the Smithsonian grounds where the remains of Smithson may be interred and a monument erected to his memory. The committee includes the chancellor, the secretary and the executive committee.

## SCIENTIFIC NOTES AND NEWS.

Dr. Wilhelm Waldeyer, of Berlin, has been elected a foreign member of the Paris Biological Society.

President Jordan, of Stanford University, will be absent from Palo Alto for about three weeks on a visit to the east. He will make an address at Yale University, at the meeting of the Association of American Universities, on February 18, and will visit other universities. Dr. Jordan has been invited to give the address at the opening of the new science building of the University of Colorado.

General I. J. Wistar, president of the American Philosophical Society, Philadelphia, sailed on February 2 for a visit to the Mediterranean and the Orient.

Dr. H. V. Hilprecht, of the University of Pennsylvania, is making arrangements for another expedition to Babylonia next fall.

The Council of the Geological Society of London has this year made the following awards: Wollaston Medal to Professor Albert Heim of Zurich; Murchison Medal to Professor G. A. Lebour of Newcastle-on-Tyne, chiefly in recognition of his work on the carboniferous rocks and in connection with coal; Lyell Medal to Professor A. G. Nathorst of Stockholm; Wollaston Fund to Miss E. M. Wood, joint-author of the 'Monograph on British Graptolites,' and assistant to Professor Lapworth of Birmingham; Murchison Fund to Dr. A. Hutchinson, demonstrator of mineralogy at Cambridge; the Lyell Fund is shared between Professor S. H. Reynolds of Bristol, who is whole or part author of several contributions to English stratigraphy, and Mr. C. A. Matley of Dublin, another British stratigraphical paleontologist; Barlow-Jameson Fund to Mr. H. J. Beadnell for his stratigraphical work in connection with the Egyptian Geological Survey. We understand that the new president is likely to be Mr. J. E. Marr of Cambridge. We regret to learn that the out-going president, Professor Lapworth, is still prevented by ill health from undertaking his professorial or presidential duties, among them the delivery of the annual address.

The Royal Society of New South Wales has awarded the Clarke memorial medal to Mr. A. W. Howitt, of Melbourne.

Dr. George F. Kunz, special agent of the United States Geological Survey, has been appointed commissioner of the radium exhibit at the St. Louis Exposition, and has been authorized to prepare and procure material comprising radio-active substances of all kinds and also exhibits to illustrate the action of radium compounds, ultra-violet light and Röntgen rays upon mineral and chemical substances. This exhibit is to be made by the United States Geological Survey in the United States building at St. Louis. There will be a second exhibit of radium and radio-active substances in the mines building.

Dr. F. H. Baker, superintendent of the National Zoological Park, will be in charge of the aviary at the St. Louis Exposition. The cage for the flying specimens, now building at the fair grounds, will be 200 feet long, 60 feet wide, and 70 feet high.

The patents of Professor Michael I. Pupin, concerned with long distance telephony, have been upheld by the German courts, as against the contention of the postal administration. Professor Pupin is at present in Berlin.

Sir William White, F.R.S., president of the British Institution of Civil Engineers, has been appointed a member of the Engineering Standards Committee.

At the annual meeting of the Anthropological Institute of Great Britain and Ireland, Mr. H. Balfour gave an address and was re-elected president.

The Zoological Society of London has elected the following members: Dr. Lorenzo Camerano, of the Royal Zoological Museum, Turin, Italy; Dr. Fritz Sarasin and Dr. Paul B. Sarasin, of Basle, Switzerland.

A society for the prehistoric study of France has been founded at Paris, with M. Emile Rivière as first president.

The president of the British Board of Trade has appointed Lord Rayleigh, F.R.S. (chairman); Sir William de W. Abney, F.R.S.; Robert Farquharson, Esq., M.D., M.P.; William King, Esq.; and J. Fletcher Moulton,

M.P.; to be a committee to inquire and report as to the statutory requirements relating to the illuminating power and purity of gas supplied by the metropolitan gas companies, and as to the methods now adopted for testing the same, and whether any alteration is desirable in such requirements or methods, and, if so, whether any consequential alteration should be made in the standard price of gas.

The Swiney prize, founded by Dr. Swiney, who died in 1844, for a work on jurisprudence, has been awarded to Sir Frederick Pollock, LL.D., D.C.L., and Professor Frederic William Maitland, LL.D., D.C.L., for their book on 'The History of English Law before Edward the First.' The prize consists of a silver cup of the value of £100 and money to the same amount. The award is made jointly by the Society of Arts and the Royal College of Physicians, and the prize, under the terms of Dr. Swiney's will, is given every fifth year on the anniversary of the testator's death.

Professor Debove, dean of the Medical Faculty of the University of Paris, has been appointed president of the French Consultative Committee of Hygiene, in the room of Professor Brouardel, who has been named honorary president. Dr. Roux, sub-director of the Pasteur Institute, has been reelected vice-president of the committee.

Professor Angelo Heilprin lectured before the People's Institute at Cooper Union, New York, on February 5, his subject being 'Mount Pelée Revisited.'

Dr. Charles B. Dudley, chief chemist of the Pennsylvania Railroad Company, delivered a lecture on February 1, at the Cosmos Club, Washington, on 'The Work of a Chemist on a Railroad.'

Lord Rayleigh will give a course of six lectures, at the Royal Institution, London, on 'The Life and Work of Stokes,' beginning on February 20.

An oil painting of the late Dr. Thomas G. Morton was presented to the Pennsylvania Hospital by the Association of Resident Physicians of that institution, January 11. Dr. Morton was connected with the hospital in various capacities for more than forty years.

We regret to announce the death of Arthur William Palmer, D.Sc. (Harvard), head of the Department of Chemistry of the University of Illinois. Dr. Palmer was graduated from the University of Illinois in 1883, and was for two years assistant in the Department of Chemistry. In 1890, after studying for two years at Harvard University and one year in Germany, he was appointed professor of chemistry and has since served continuously in that capacity. As member of the Chemical and Biological Survey, he had lately completed an important report on the water supply of the state of Illinois, and was the author of many papers embodying the results of chemical investigation.

The Rev. Dr. Jacob Cooper, professor of philosophy and rhetoric in Rutgers College since 1893 and previously professor of Greek, has died at the age of seventy-three years.

Dr. Friedrich von Hefner-Alteneck, the eminent German engineer, died on January 7 at the age of fifty-eight years.

Reuter's Agency reports that on January 16 the chief of the laboratory of the Imperial Institute of Experimental Medicine for the preparation of plague remedies, whose name is not given, was taken ill after having been engaged in experimenting with living plague cultures. He died of plague on January 20, in spite of every medical assistance and repeated injections of anti-plague serum. Injections of the anti-plague serum were made in good time into all persons who had been in contact with him. The laboratory is in Fort Alexander I., which is on a small island completely isolated from Kronstadt and the other forts.

Dr. Felix Kanitz, known for his archeological and ethnographical researches in the Balkan peninsula, died at Vienna on January 5, in his seventy-fifth year.

We also regret to record the death of Dr. August G. Garcke, professor of botany at Berlin, at the age of eighty-four years.

A despatch from Buenos Ayres to the *Figaro* announces that the *Français,* with

Dr. Charcot's antarctic expedition on board, reached Ushuaia, Patagonia, on January 15. An Argentine vessel brought her coal supply and mails, and the *Français* then left for the south.

THERE will be a civil service examination on March 9 and 10 to fill vacancies in the position of geologic aid and assistant geologist in the Geological Survey, at salaries ranging from $1,000 to $2,000 per annum.

BARON LÉON DE LENVAL, of Nice, has given 3,000 francs to found a prize to be awarded periodically to the otologist who has made the greatest progress in the practical treatment of the affections of the ear since the previous award, to the inventor of a portable apparatus susceptible of notably improving the hearing of deaf persons. The value of the prize is the interest on this sum accruing in the interval of two meetings of the International Otological Congress.

*The Illustrated Review of Physiologic Therapeutics* offers the sum of fifteen hundred dollars in cash prizes for the best essays on X rays in medicine and surgery, the first prize being $1,000.

SIR NORMAN LOCKYER's address as president of the British Association for the Advancement of Science on 'The Influence of Brain Power on History' has been reprinted from *Littell's Living Age* by the New England Education League and International Education Conference. Copies may be obtained in large or small quantities at the rate of two cents each (postage extra) by addressing Mr. W. Scott, secretary, 40 Dover Street, West Somerville Station, Boston, Mass.

SENATOR CULLOM has introduced a bill for the preservation of aboriginal monuments, ruins and other antiquities to apply to all government reservations.

THE agricultural appropriation bill, as passed by the house on February 5, carries a total of $5,711,240, being an increase of $233,080 over the current law. Only two salaries are raised by the bill, and these only temporarily, being $500 each to the chiefs of the Bureau of Animal Industry and the Division of Entomology. Commenting on the amount carried, Chairman Wadsworth says in the report: "It has been asserted by some that the United States is not spending enough toward the promotion of agriculture. Having this in mind your committee requested the Census Bureau to furnish it with statistics showing the amounts spent by the several states and territories for this purpose, and as near as can be ascertained by that bureau the aggregate yearly expenditures by the states and territories are something over $4,500,000, which, added to the $6,250,000 spent annually by the United States government for the same cause, makes a total of $10,750,000 spent annually for the promotion of agriculture. Certainly," the report concludes, "this is a most liberal figure and much more than is being expended by any other government in the world for the same purpose." The bill contains the following new clause regarding the relation of the agricultural experiment stations to the Department of Agriculture: "The Secretary of Agriculture is hereby authorized and directed to coordinate the work of the several stations and the work of the stations with the Department of Agriculture, to the end of preventing unnecessary duplication of work, of increasing the efficiency of the stations and the Department of Agriculture, and to unify and systematize agricultural investigations in the United States."

IT appears from the reports in the press that in discussing the agricultural bill in the house on February 5, Mr. Sheppard (Dem., Texas) made a determined but vain effort to bring about a reform in the matter of the distribution of seeds by the government, and specially for the purchase of rare and untried seeds. He read a letter from a constituent who asked him to send certain seeds and in addition a suit of clothes. He declared that the system was degenerating into a farce, and said that if the congressional comedy continues and drifts into a continuous performance, congressmen will no longer be statesmen but seedsmen. Mr. Sheppard developed to the merriment of the house, in a colloquy with Mr. Candler, that the latter had received a request from a man for a hat for himself and his wife. Mr. Cochran (Dem., Mo.) said he re-

ceived a letter from one of his constituents a few months ago asking for a piano for his daughter. Mr. Cochran wrote back that he was very sorry that he could not gratify him, but he was in the minority and could not get any allowance of pianos. However, he said, Mr. Bartholdt, being the only republican from the state, could get all the pianos he wanted. He had just received twelve as his allowance. In a few days Mr. Bartholdt got several letters asking for pianos, and now he is receiving four or five letters every day from Missouri making the same request.

A correspondent writes as follows to the London *Times* with reference to Mr. J. S. Budgett, of Trinity College, Cambridge: By the death of Mr. Budgett Cambridge has lost one of the most promising of her biologists and one of the most active of those who take an interest in volunteering in the university. Mr. Budgett was educated at Clifton College and came up to Trinity College about ten years ago. From early childhood he showed a keen interest in all matters of zoological interest; and these tastes whilst he lived in his father's house at Stoke Bishop, near Clifton, were fostered by the friendship and sympathy of Professor Lloyd Morgan and of Professor S. H. Reynolds, of University College, Bristol. During his third year at Cambridge Mr. Budgett accompanied his friend Professor Graham Kerr to the Gran Chaco of Paraguay, where he made large collections of the local fauna, especially of amphibians and birds. Returning to Cambridge, he took his degree in 1898, and almost immediately started for the Gambia. Here he remained the best part of a year endeavoring to secure material for the study of the development of the archaic fish *Polypterus*. He revisited the Gambia in the rainy season of 1900 with the same object; and although in these trips he did not absolutely succeed in his object he collected a vast quantity of valuable material, notably a complete series of the eggs and larvæ of the African lung-fish, *Protopterus*, and of several other fresh-water fishes and amphibians. In 1902 Mr. Budgett was appointed Balfour student in the university, and with indomitable courage he renewed his efforts to solve the riddle of the development of *Polypterus*. He set out in June for Uganda, and proceeding from Mombasa by the Lakes Victoria and Albert, his caravan reached the head waters of the Nile, and he finally returned home by the Sudan and Egypt. Last June he started on his fourth and at last successful expedition to Africa. On the delta of the Niger he found what he had so long and courageously sought, and he returned home last November with a complete series of eggs and larvæ of *Polypterus*, and immediately began to work up the material he had collected. On his return it was evident that his health had been affected by the climate. Mr. Budgett was a man gifted in many ways. His power with the pen and pencil were a great help to his scientific work. In 1901 he raised a detachment of mounted infantry in connection with the Cambridge volunteers, and has continued to command that body till his death. He was a man of strong personality, and of a high and sensitive personal honor.

The fifth International Congress of Zoology, held at Berlin in 1901, selected Switzerland as the place of meeting for the sixth session, and elected Professor T. Studer president. *Nature* states that in accordance with this resolution, the congress will meet at Bern from August 14–19 of this year. Professor Studer, Bern, is president of the general committee, and the vice-presidents are: Professor E. Beraneck, Neuchâtel; Professor H. Blanc, Lausanne; Dr. V. Fatio, Geneva; Professor L. Kathariner, Fribourg; Professor A. Lang, Zürich; Professor E. Yung, Geneva, Professor F. Zschokke, Basel; and Professor R. Blanchard, Paris. The secretaries are Professor M. Bedot, Geneva; Dr. J. Carl, Geneva; and Dr. W. Volz, Bern. The general meetings will be held in the Palace of Parliament, at Bern, and the sectional sittings in the new university. During the congress there will be an excursion to Neuchâtel and to the Jura lakes, in order to visit the lake-dwellers' settlements. The closing meeting of the congress will be held at Interlaken. Afterwards members will be invited to visit other Swiss cities. Communications or inquiries referring to the con-

gress should be addressed to the president of the sixth International Congress of Zoology, Museum of Natural History, Waisenhausstrasse, Bern. The congress is open to all zoologists and to all who are interested in zoology.

Columbia University, in cooperation with the Academy of Political Science, has arranged for a series of nine free lectures on 'The Problems of Municipal Administration,' to be given in Earl Hall by the heads of departments of the last city administration. The lectures are to be as follows:

February 26—'The Dock Department' (illustrated), McDougall Hawkes.

March 4—'The Street Cleaning Department' (illustrated), John McG. Woodbury.

March 11—'The Police Department,' Gen. Francis V. Greene.

March 18—'The Fire Department,' Thomas Sturgis.

March 25—'The Board of Education,' C. C. Burlingham.

April 1—'The Department of Charities,' Homer Folks.

April 8—'The Tenement House Department,' Robert W. DeForest.

April 15—'The Health Department' (illustrated), Dr. Ernst Lederle.

April 22—'Bellevue and Allied Hospitals,' John W. Brannan.

*The British Medical Journal* states that new county buildings at Chelmsford containing laboratories for Essex were formally opened recently by the Earl of Onslow, president of the Board of Agriculture. The new buildings, which are conveniently situated near the center of the town, have cost about £12,000. They comprise chemical, physical and biological laboratories and class rooms, together with agricultural and horticultural museums and libraries, and provide facilities for systematic instruction in agriculture and horticulture, as well as in pure science. They are under the control of the Essex Education Committee, and were built by the Essex County Council. As the chairman of this committee, Mr. E. N. Buxton pointed out at the inaugural proceedings that Essex was an agricultural county and the laboratories were intended to be a center for agricultural or horticultural information for the whole county; they included rooms for the analysis of soils, manures, foods, seeds, etc., and for other scientific work carried on in the interests of these industries. There is also a large dairy, in the basement, for instruction in butter and cheese making and the treatment of milk, and within three quarters of a mile is the school garden, three acres in extent, provided with potting-shed and hothouses. In addition to the more purely agricultural and horticultural courses of lectures and practical work, classes are held in chemistry, physics and biology, largely for the training of teachers. Several scholarships are offered by the county council, while several of the classes are free to selected candidates resident in Essex. The laboratories are large, well arranged, and well fitted up, and should prove, with the agricultural departments, of great service to the cause of agriculture and technical education in Essex. In the prospectus of the dairy school it is stated that 'it is also proposed to give a one-week's course of instruction in milking and the treatment of milk for selling.' Such a course, if properly given and attended, should be of value in promoting a more satisfactory and hygienic treatment of milk, and will be welcomed by all interested in a pure milk supply.

Professor Harry Fielding Reid, of Johns Hopkins University, who is in charge of earthquake records for the United States Geological Survey, was designated by the State Department as the delegate from the United States to the International Seismological Conference held in Strassburg last July. The object of the conference, which was held at the invitation of the German Government and was attended by delegates from nineteen countries, was to form an International Seismological Association of the various countries for the purpose of cooperative work in such earthquake investigations as could be carried out only by cooperation. The conference adopted a constitution, which is to be submitted to all civilized countries, and they will be asked to join the association. The constitution provides for a general assembly, to meet at least once in four years, and a permanent commission, composed of one delegate from each

nation, which will direct the work of the association in accordance with the resolutions of the General Assembly. A Central Bureau is to be located at Strassburg in connection with the Imperial Seismological Station there, and reports are to be forwarded to its director as frequently as possible. These reports will be edited and published. The nations, members of the association, are to contribute sums varying from $100 to $800 annually, according to their population. The amount thus obtained is to be used for the expenses of administration and publication and may be used in part for such special purposes as the prosecution of special investigations ordered by the General Assembly or for the support of particular observatories founded by the association, observations from which are considered of special importance, and which could not otherwise be made. Each country is to enjoy the utmost liberty in the method of making observations and in the choice of instruments, but the reports are all to be sent to the Central Observatory in terms of Greenwich civil time.

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## *UNIVERSITY AND EDUCATIONAL NEWS.*

Professor John Hays Hammond has added $50,000 to his previous gift of $50,000 for a metallurgical laboratory of Yale University.

The late James A. Woolson has left his property in trust for his wife and daughters and their issue, if any, after which it is to go to public purposes. Boston University will ultimately receive $600,000, Radcliffe College $300,000 and the Wesleyan Academy at Wilbraham, Mass., $300,000.

The University of Michigan has received from Arthur Hill, of Saginaw, eighty acres of land just outside Ann Arbor, to serve as an experiment farm for the Forestry Department. The tract is called 'The Saginaw Forest Farm.' The tract is to serve as an object lesson in forestry and is planned to provide for: (1) An arboretum of all useful forest trees suited to Michigan. (2) Demonstration areas for seed bed and nursery work. (3) Model plantations of forest trees. (4) Special experiments in forestry, such as the various methods of propagation of special kinds of timber and the raising of particular kinds of forest products, as well as for other practical purposes. The university has also received from Mr. Joseph B. Whittier, of Saginaw, $4,000 for the Angeline Bradford Whittier fellowship in botany, in honor of Mr. Whittier's mother, and from the Michigan Federation of Women's Clubs, $3,000 for a scholarship for women. The sum will later be increased to $5,000.

Mr. Alfred Palmer has written to the principal of University College, Reading, offering to present to the college a site for the proposed new college buildings. The extent of the gift is about five acres, centrally situated.

President Ira Remsen, of the Johns Hopkins University, will give the commencement address at the Worcester Polytechnic Institute in June next.

The new medical laboratories of the University of Pennsylvania will be dedicated next June, and the medical department will move into its new quarters during the summer.

The Northwestern University has established in the College of Liberal Arts one hundred scholarships open to students from any part of the country who may be able to comply with the conditions. The scholarships are to be assigned upon a new basis, which resembles in some respects the Rhodes scholarships. The chief emphasis in the selection of students will be laid upon promise of superior achievement or probable fitness for public usefulness after leaving college.

Mortimer E. Cooley, professor of mechanical engineering at the University of Michigan, was appointed dean of the engineering department at the last meeting of the regents. He succeeds the late Charles E. Green, who was dean of the department from its foundation until his death in October last.

At University College, London, the Derby scholarship in zoology has been awarded to Mr. W. N. F. Woodland.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 19, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SECTION I, SOCIAL AND ECONOMIC SCIENCE.*

THE St. Louis program comprised four regular sessions, in addition to that of the delivery of the retiring vice-president's address by Mr. H. T. Newcomb, on 'Some Recent Phases of the Labor Problem' (SCIENCE, January 8, 1904). This address was made the basis of discussion at the first regular session, which was occupied with papers and discussions on the labor problem generally. The second session, on economic aspects of the new agriculture, was held jointly with the Society for the Promotion of Agricultural Science. The third session dealt with the status of instruction in social and economic science in schools, colleges and universities; and the fourth included papers on commerce, finance and government. All the sessions were presided over by Hon. Simeon E. Baldwin, of the Yale Law School, New Haven, Conn. The other officers were as follows:

*Secretary*—John Franklin Crowell.

*Councilor*—Marcus Benjamin.

*Sectional Committee*—Simeon E. Baldwin, vice-president, 1904; John Franklin Crowell, secretary, 1904–08; H. T. Newcomb, vice-president, 1903; Frank H. Hitchcock, secretary, 1903; E. L. Corthell (one year), Carroll D. Wright (two years), B. E. Fernow (three years), Frank R. Rutter (four years), Wm. R. Lazenby (five years).

*Member of General Committee*—Allen Ripley Foote.

The following papers were contributed:

*Functions of Forestry in the New Agriculture:* Thos. H. Sherrard, Bureau of Forestry, Department of Agriculture, Washington, D. C.

Mr. Sherrard's paper dealt with the problem of forest culture, as it related to farming rather than to lumbering, and showed the work of the Bureau of Forestry to this end. Instead of a struggle to win tillable land from the forests the farmer is more often confronted with the difficulty of obtaining building material for his house and wood for his home use. With the growing appreciation of the urgent need for forest preservation, the demand for better methods for handling wood lots to secure their permanency takes a more and more important place. How important is conservative management of wood lots from the standpoint of national economy may be seen from the fact that from one third to one half of the forests of this country are in the hands of farmers. In the new agriculture, the spirit of which is to use every part of the land, forestry has an important place. Just as the new agriculture requires the highest possible production along other lines, so with equal reason it demands that the wood lot should be managed to produce as much wood as possible. The Bureau of Forestry in the Department of Agriculture in the past five years has introduced practical forestry upon over a million and a half acres of private forest land, with applications for assistance covering five and a half million acres.

In principle forestry is an exceedingly simple matter, but its application requires the trained man. The warp and woof of forestry is silviculture—the science of guiding forest growth so that it will best meet the individual need.

The manner of treating these applications involves an examination of the tract by an agent, a report on the same and a recommendation of a working plan if deemed advisable. The Bureau makes the working plan. In the case of large tracts the expense of the field work, necessary to the preparation of the working plan, and the cost of its execution, is borne by the owner. In the case of wood lots with an area not exceeding two hundred acres, the expenses are borne entirely by the Bureau. The purpose of the woodlot work is two-fold. *First,* to assist the individual owner, in applying such management to his woodlands as will make them most productive and profitable. *Second,* to encourage, by examples of forest management, a more general understanding of the simple principles underlying forestry. In almost every case owners have asked help of the bureau, because they have a very definite problem of their own to solve. A large proportion of men counting on permanent ownership of their land have wished to know how and where to cut their annual supply of cord wood and such material as they require, so as constantly to improve the value and productiveness of their woods.

*Improvement in Farm Management:* W. H. Hays, Minnesota State Agricultural Experiment Station, St. Anthony, Minn.

Referring to the 838,591,774 acres in this country, of which 414,498,487 acres were under cultivation and 424,093,287 acres not yet under cultivation, the problem of farm management is, How can the nation and the state assist so that these separate farms and farm-houses may be so well managed that they shall not be supplanted by a system of estates with their centrally located farmsteads and their peasant-like employees? Shall our government and states provide simply higher institutions of agricultural learning to educate managers of large estates, and thus follow the present tendency to centralize industrial work under a few managers? Or shall the

government and the state aid in providing technical education to the great mass of farmers so that the practical farmer can sustain himself and maintain a strong position in life? Technically educating the whole of the farmers and making it possible for each to remain in the life-school of independent business experience, by means of consolidated rural schools, agricultural high schools and the central college—is the answer, which has been worked out to some extent so successfully in Minnesota. (See *Review of Reviews*, October, 1903.) The cost as compared with the present developing systems of schools might be larger, but the immediate economic benefit from enlarged farm production would several times over pay the increased cost.

The next problems are to accumulate the facts, the philosophies and the processes which a scheme of education should teach, and to reduce them to pedagogical form. The teachers and experimenters of America have worked out many of the details of farm management, but have not vigorously taken up the farm as a whole. The soils, the crops and the stock, and the manufacture of farm crops into finished products have been investigated as individual features. These investigations of the parts have reached that degree of development where it seems practicable to take up the problem of managing the farm as a whole. In fact, a few teachers and experimenters have in a preliminary way blocked out some of the more general problems.

There is imperative need of facts as to the relative value per acre of the several crops adapted to a given farm; the cost of labor, seeds, buildings and machinery required for each crop; the amount of its beneficial or injurious effect on the land; the time of year when it requires labor; the desirability with which it dovetails in with other crops and with the care of live stock; and the value per acre of each crop when marketed, or manufactured into meat, milk, sugar or other finished product before marketing. A knowledge of how to arrange the sequence and the proportions of the best paying crops into the most profitable combination of crop rotation with live stock is a necessity.

*Economic Functions of Live Stock:* CHARLES F. CURTIS, Iowa State College, Ames, Iowa.

The fertility of the soil as part of the nation's working capital returns an annual dividend proportionate to the intelligence of methods employed. However large the crop, not more than one per cent. of the soil's total supply of plant-food is exhausted by a single crop. Otherwise one generation might impoverish another completely by robbing the soil of its resources. Maintenance of fertility is secured by rotation of crops, by chemical fertilizers and by bacteriological methods. But by none of these has the virgin strength of the soil been maintained over long periods except as plant production has been associated with animal husbandry. By selling products (butter) and restoring by-products we take from the soil but one tenth of fertility lost by a grain crop. Grain growing and animal husbandry are complemental industries, the one a summer industry and the other a winter industry.

Thus the latter is necessary to furnish continuous employment for farm labor throughout the year, the demand being greatest during the winter months when there is a cessation of field work, and lightest during the summer when the field work is most exacting. The live stock industry is, therefore, admirably adapted to supplement grain growing in its labor relations.

Then again, it contributes to a more economical use of plant food that may be

added to the soil through feeding stuffs than by any other means. If fertilizing material must be bought for the farm, it can, under all ordinary conditions, be bought in vastly cheaper form as feed stuffs and utilized as such, and the residue applied to the soil, than by purchasing fertilizers outright. The very best of fertilizers are often obtained in this way without any direct outlay. The use of feed stuffs, rich in fertility, may even return a handsome profit as a separate proposition, and thus fertilizing constituents come on to the farm under most advantageous circumstances. The British and the European farmers buy large quantities of our flaxseed and corn by-products. They figure that they are the gainers even if they do not make any profit on their feeding operations with these products, and they are. Until recently the packing house by-products, including dried blood and tankage in various forms, have practically all gone direct to the land as fertilizers. To-day these products are serving a most important purpose as feed stuffs, and the time is near at hand when practically every pound of this material will first be utilized as stock food, and later returned to the soil. The returns are so much greater and so much more economical in this way as to put the purely commercial fertilizer farmer out of business in the space of a few years at the outside, where other conditions are similar.

It is true that fertilizers can not all be bought in the form of stock foods. In some cases it may not be practicable to combine stock raising with the system of agriculture being practised. These conditions are the exception, however, and they do not apply to the distinctive and most productive agricultural regions of our country.

If the seven southern states that annually expend $20,000,000 for commercial fertilizers, would stock their farms, feed their cottonseed meal, instead of exporting it, buy other feed stuffs rich in plant food, rotate with the legumes and practise the best known methods of cultivation in soil tillage, they would in a short time be independent of the fertilizer dealers, and save the vast expenditure which is now such a drain upon the resources of that section of country.

The information, which has gone out recently with scientific endorsement from high authority, to the effect that soil fertility may be maintained indefinitely without resort to fertilizers of any kind, might be viewed with grave alarm if it were to be taken literally. Likewise the doctrine that the deficiencies in soil constituents must be determined by chemical analysis and supplied by chemical fertilizers is equally pernicious. The manifest tendency in regions where farmers rely upon commercial fertilizers, like the tendency where men rely on stimulants, is to use them to excess, and when they are not necessary or profitable.

*Agricultural Economics:* H. C. TAYLOR, University of Wisconsin, Madison, Wis.

"The modern farmer produces primarily for the market. This is the chief characteristic of modern commercial agriculture as distinguished from the self-sufficing agriculture of earlier times. * * * The well-being of the modern farmer does not depend, therefore, upon his capacity to produce for himself the things which he wishes to consume, but upon his capacity to win profit in agricultural production. To win the largest net return is then the goal of modern commercial agriculture; and if the economist wishes to make himself useful to the farmer he should undertake, first of all, to solve this problem." This principle was applied to the selection of land, to the selection of crops for the field system by groups of competing and

non-competing crops, to the size of the farm best suited to the farmer, and to the questions of ownership, tenantry and forms of rental.

Where intensive culture is desired, the renting of land on the shares naturally gives way to a cash rent system which requires careful regulation if the best interests of all are to be conserved. As competition for the use of land grows more and more keen all of these questions become of vital importance to the farmer, and of real significance to the country as a whole. The study of the past experience and present practises of older countries, England and Germany, for example, is helpful; but it is of vital importance that the student of these problems be thoroughly familiar with conditions at home.

*Evolution of Agriculture in the Middle West and its Social and Economic Significance:* Eugene Davenport, State College of Agriculture, Urbana, Illinois.

This paper, after describing agricultural conditions in the west and pointing out radical changes both in the farm and in the farmer, concluded as follows:

1. Agriculture is eminently profitable and the farmers are not to be reckoned as among the poor of the earth.

2. Farming, as now being organized, is not exhausting the fertility of the soil, but is on a permanent basis and, therefore, the future of the industry and its people is practically assured.

3. That it is raising the value of lands at a rapid rate, thus making the man and not the acre the unit of farm value, the acre being worth its capitalized income.

4. That it is becoming too difficult an occupation, especially on the better lands, for men of inferior ability lacking in special knowledge and training.

*Relation of the Family to the Labor Problem:* Rev. John W. Day, Church of the Messiah, St. Louis, Mo.

We must recognize the importance of the part played by the home in the making of the labor problem and the influence it may have in the working out of the problem. The reply made by John Mitchell to the inquiry whether the 'lives of the wives and children' of the men he had condemned as traitors to the laborers' cause because they worked independently of the union, ought to be made unendurable, was:

'I think those wives and children had better ask their fathers.'

In this significant reply there is the assumption of a superior loyalty than that to the family. The union claimant asserts therein that the real interest of the family lies in absolute subordination to the union. The union disclaims responsibility for any harm that may come to the outside family through its action. The welfare of the family can only be considered through its subjection to the union organization. 'Let the fathers answer that question' means that the family can not command their central loyalty, that the union acknowledges no duty to the family as such, but only to the family as a part of itself. The union thus becomes the modern feudal lord whose protection the family must obtain in vassalage and may disregard only at its peril.

It is obvious that where this principle is accepted the influence of the family in the unionist conflicts will be to sharpen feeling and heighten purpose. A motive stronger than loyalty to a class, stronger than trade fidelity, stronger than patriotism, is thus vitally connected with any cause the union may espouse. This must be an unreasoning attitude, and must have the unequaled force of sentiment. The association of ideas is immediate and inseparable, and the strength of the union must be

multiplied by the family feeling existing among its members. The potency of the feeling thus intensified is incalculable. It must always be borne in mind in estimating the power of the union.

As this is one of the strongest bonds of union loyalty, so it is the most serviceable weapon of defense and attack. The social expression of the boycott is the evidence of this. So entirely are the currents of family feeling identified with union loyalty that even when the family is divided against itself the stream often follows the union branch rather than the family direction. A mother whose son lay dead in her house could declare without compunction that it served him right to be killed for working outside the union. The compulsion of family interest forces compliance where personal interest alone would not avail. This leverage, when possessed by the union, is of mighty and varied application.

Nor does the suffering borne chiefly by the family in protracted strikes seem to counteract this tendency. Those who have been nurtured in the atmosphere of the unionized family are likely to endure hardship in the spirit of martyrdom, and the blows of pain but weld a firmer bond of sacrificial devotion. Whatever protest there may be is absorbed by a loyalty tried as by fire.

Only the last pinch of necessity can compel yielding for the sake of the family, and such compulsion does not modify the intense feeling which springs from the amalgamation of the sentiment of home protection with union preservation.

The modifying influence of the family in the conflicts of labor unions with employers is chiefly to be found in connection with non-union labor. When wives and children ask fathers who have decided that they have the highest right to the exercise of industrial liberty whether their lot is to be made unendurable, the answer is likely to be one that unionists will not hear with indifference.

What considerations specially warrant the expectation that this modifying influence will be increasingly potent?

The elevation of the family into a position of central interest is a feature of the times. The wider range of comforts within reach of industrial families; the influences of refinement and culture through public school education, through libraries and by the press; the multiplied points of contact between families hitherto socially separate, of which the social settlement work is a remarkable manifestation and a sure prophecy; the stimulus to family pride through the operation of the principles of modern democracy; the intrinsic purifying of the family ideal, of which even its apparent contradiction in freedom of divorce is partly an evidence, since in spite of license and often by means of liberty the welfare of the family does not suffer and even improves so far as it is given a natural rather than an artificial root; the suggestions conveyed more imperatively through family influences than by any other toward thrift, good habits, and affectionate ambitions; these are influences which, when gained by independent industry, will work mightily toward mitigating the constraints which hamper true industrial development.

They are influences of intrinsic primacy and, while held in check by an arbitrary and mechanical structure, which lacks some of the essential elements of vital organization, they will inevitably gain their legitimate ascendency and compel reconstruction.

Let the laboring man see the real preeminence of the family; and value at its possible worth his own fireside, let the family be made by all the helps of civilization such that he must see its supremacy, and he will have a rallying cry

for a new reformation. When the welfare of their wives and children really becomes the chief concern of their supporters, the unions whose leaders insolently claim infallibility of judgment and indisputable rights of disposition will learn over again the lesson long ago forced upon an intolerant and intolerable ecclesiasticism.

They will learn that the natural rights of man are first in right, and will at the last be first in fact, that nothing can stand against the right and duty of a man to exercise his private judgment, to work out his own industrial salvation, and to set before every other loyalty the loyalty to the highest and most sacred of human obligations.

*Mutual Insurance for Prevention of Strikes:* Edward Atkinson, Boston, Mass.

It is commonly believed that laborers are organized, using that term in its application to working people, male and female. This assumption is without any foundation in fact. There are to-day over 30,000,000 male and female working people, including farmers and farm laborers, earning their living for compensation in money, or, according to the common expression, mostly 'wage earners.' They are, as a body, without organization. On the other hand, a small fraction have organized what are commonly called trades unions.

It is not probable that five per cent. of the working people of this country belong in all these unions combined. They are not federated or organized for any common action and as they rarely fail to antagonize one another they may be said to represent the disorganization of labor rather than its organization. On the other hand, large amounts of capital are organized in corporations, trusts and combinations.

It is not to be inferred from this statement that any exception is taken to the organization of trades unions. They are a natural outcome of modern conditions of industry and are due in a large degree to the displacement of the individual manager of mills and workshops by the corporations. Trades unions are schools, but they are as yet primary schools, in the study of social economy. As their members become individually more and more competent to manage their own affairs, they cease to adopt violent and aggressive methods; they witness more and more the evils of strikes and boycotts, and they are now passing into the next stage above the primary school, which will by and by qualify them for the high school course in the organization of labor.

Neither is it intended to affirm that all capitalists or greater employers act with intelligence in dealing with workmen. Strikes, boycotts, violence, force and lockouts are often indications of the ignorance on the part of workmen and of ignorant capitalists. Therefore they are evil. They have destroyed the harmony or community of interest which in the nature of things exists in the relation of labor and capital, which harmony and community of interest can only be disturbed by lack of intelligence on the part of laborers and capitalists alike, one or both.

Is there any way in which the necessary harmony between capital and labor can be brought into effect by capitalists and workmen? Possibly there may be. Manufacturers and employers of labor in many branches of industry and in many parts of this country are now planning to combine for mutual insurance against a loss by strikes. When a great factory of any kind is stopped by a strike, what are called the fixed charges run on; only the wages are saved. The officers, the heads of departments, many of the highest class of employees, who seldom belong to a trades union, must be continuing the service and

must be paid. The taxes, the general expenses and the cost of insurance and other charges continue.

In a rough-and-ready way one may take as a standard proportions which are almost an example of general average. We find the cost of materials which are converted in the factory or workshop into finished forms ready for final sale comes to fifty or sixty per cent. of the total cost of the finished product. The fixed charges come to about five per cent. The wages of the workmen come to from twenty to thirty per cent., seldom more. The plan for this organization of capitalists is that each shall make a small annual contribution or premium, so called, to a mutual insurance company, which shall assure to each member so many dollars during the term of a strike, at the rate of about five per cent. of the value of the total product for one year. Other similar combinations prove that such an organization for mutual insurance against loss by strikes would be simple, sure and safe at a very small ratable charge each year upon each member.

It may be here remarked that the middle body of non-union workmen, the most competent and capable of the number, may be the victims of a lockout on the part of the employers or of a strike on the part of the union. They may be ground between the upper and the nether millstone, with no fund except their own savings, and with no organized body to protect them by legal or other service against the abuses either of the employers or of the unions. As the oppression of trades unions has become plain, we witness what may be called the beginning of an organization of free laborers in many parts of the country. Workmen are now combining to bring to the support of their individual rights the funds that they may subscribe, and to do what is yet more important, to organize and direct public opinion in support of the free laborers.

What next? It would be a very plain and simple work for the corporations or individual owners of capital, who are now organizing and combining for mutual insurance against loss by strikes, to call upon the non-union workmen or free workmen of the country to join in that organization—each workman to contribute such small premium as will be required and to assure to himself such number of dollars a day as his contributions will warrant during the term during which the free laborers are deprived of work by the strike on the part of the trades unions. If this organization of labor and capital for mutual insurance and support were once established, many of the workmen, who are now joined in the trades unions because there is no other place where they can go, would leave them to join the mutual union of the free laborers and the free employers. In this way the antagonism of laborer and capitalist would be displaced by the mutual service of labor and capital.

*When Labor is King:* Alisan Wilson, Washington, D. C. Read by title.

*Status of Social and Economic Science in High Schools:* W. J. S. Bryan, Principal, St. Louis High School.

To ascertain what work is done and what estimate is placed by high school men upon the value of the study of social and economic science in high schools, letters were written to the principals of seventy-five representative high schools. They were asked to answer four questions:

1. What instruction in social and economic science is given in your school?

2. In what grades is such instruction given?

3. How many pupils are engaged in such study?

4. In your opinion what is the value of such instruction and what should be its place in the course of study of secondary schools?

Answers were received from fifty-six schools. Replies to the first question show that in twenty-one schools no instruction is given; that in twenty-one, political economy is taught; in four, civics; and that in nine, such instruction is given only incidentally.

The amount of time given to such study is forty weeks in thirteen schools; twenty weeks in fifteen schools; ten weeks in two schools.

From the answers to the second question it is learned that in twenty-one schools instruction is given in the fourth year; in ten schools in the third and fourth years; in three in the third year; and in one in the second year.

In the fifty-six schools named instruction in social and economic science is given to 1,152 pupils specifically, and to 2,681 incidentally.

The fourth question elicited interesting replies. From these expressions of opinion it appears that there is considerable diversity of views, ranging from pronounced disapprobation to emphatic approval. Twenty-four are of the opinion that it is a very valuable subject, second to none. The general opinion favors the last year of the four years for the study, on account of maturity of the pupils and their awakening interest in the problems of the day, and also on account of their previous acquisition of knowledge essential to apprehension of the present stage of civilization, domestic, economic, political, religious, educational.

The great service of social science will be the discovery and statement of the laws of association in obedience to which men may live together in a state of freedom and attain the fullest individual development. In the secondary schools originality of thought is not to be expected. To rediscover and verify and apply the laws discovered and announced by science of every kind is the immediate task of secondary pupils. More they must not be expected to do. The complex social organism with its fivefold execution, the family, society, the state, the church, the school, furnishes a subject of study that demands sustained attention, concentration of mind, apprehension of principles, familiarity with history. If this study of institutions be undertaken late in the course, when the effect of previous years is apparent in power of concentration and the vigor of grasp, it may be made extremely profitable. It is only by a study of institutional life around us that we awake to a consciousness of our relation to our material, social and spiritual environment. The world of the individual is commonly limited by sight, hearing and touch. The debt of obligation to the great institutions through which he is made partaker of all the results of centuries of struggle and trial and sacrifice and suffering is not realized.

To give a youth rational conceptions of the presuppositions of present social conditions and spirituality of ideals is to render him and society a much-needed service. A teacher who is imbued with the importance of the subject will make opportunity for its introduction, but its close relation to history is apparent. The evolution of institutions is the theme of history. After a course in general history sufficient time should be given to a systematic study of the evolution of institutions whose existence conditions the life of to-day, that it may appear from what beginnings and through what modifications social order has been developed. From this study of institutions doubtless there will come a more intelligent comprehension of the process of civilization, a juster appreciation of present conditions, and a sincere and earnest desire to contribute to their betterment and to serve the cause of social elevation.

*Status of Instruction in Social and Economic Science in Normal Schools:* Henry W. Thurston, Chicago Normal School, Chicago, Ill.

Special reports from forty-three representative normal schools in twenty-seven different states show that ten of them have courses in sociology, seventeen in economics and twenty-two in civics.

In practise there is yet no agreement among normal school men that a course even in elementary civics—to say nothing of economics and sociology—is needed by teachers in elementary schools.

Still there is a large and influential body of opinion in favor of the study of all three of these social sciences by even those teachers whose work will be confined to the lowest grades. Some of the reasons of this opinion are:

1. Economics and civics are needed to enable a teacher to teach specific work in these subjects in the lower schools, but to teach geography, history and current events properly, the economic and political elements in these subjects being so fundamental, are necessary.

2. As the individual can not come to a knowledge of himself and his own powers except through his social relations, the teacher must know those social conditions that are fundamentally necessary to the normal development of his pupils.

3. The individual hungers for intelligence and efficiency in the world of human institutions as well as in the world of things.

4. A democratic society needs a greater and greater social and ethical efficiency on the part of all its citizens.

5. The civilization of any age tends to educate its young in the direction of its own greatest needs, hence we are in the midst of a movement toward a better social education of our children whether we will or not.

Among the more immediate steps toward better social education the following are suggested:

1. Such an agreement among normal and their tributary high schools that courses in at least civics and economics may be prescribed in one school or the other for all prospective teachers.

2. Normal schools should keep pace with other professional schools in lengthening their courses and raising the standards, including social education, for teachers.

3. Where courses can not be lengthened some way of emphasizing the opportunities and duties of teachers in the social education of their pupils must still be found.

4. There is need of greater intercommunication among normal school teachers in order that the best things in any school may become contagious in all.

*Work of the College in the Formation of Social and Economic Opinion:* Robert J. Sprague, Knox College, Galesburg, Illinois.

From figures comparing colleges and universities as represented by their graduates in congress, it was concluded that the university had evidently given a greater stimulus to the study of economics and social science than the college had. This result was attributed to the comparative slowness of the college in providing departments of social and economic science. College extension work was advised in the locality to establish an educational unity between town and college as to which the narrow sectarian spirit of the college and community often stands in the way. Evening classes open to adults and supported by the municipality afford excellent opportunity and present a new line of duty in smaller cities and towns especially, where such facilities are lacking. Finally, the cooperation of the newspapers is one of the most helpful agencies to the work of the

college in molding and enriching public opinion in social and economic lines. Each college should have at least a good teacher of economics and social science, who, with a good working library, could readily meet these requirements.

*Status of Instruction in Social and Economic Science in Universities:* J. H. Hagerty, Ohio State University, Columbus, Ohio.

The first thing that is to be noticed is the crude, imperfect and illogical classification of the so-called social sciences. So indefinite is our classification and so imperfect our nomenclature that a layman has hard work to discover the difference between socialism and sociology, political economy and civilization, and does not know what anybody means when he says 'political science.' There are three distinct lines of instruction in most universities, but they are so confused in their classification as sometimes not to be readily discovered. These are politics, economics and sociology. Frequently all of these are classified under 'sociology,' again under 'economics' and again under 'political science.' In reality the terms 'social science' and 'political science' should never be used, but 'sociology' and 'politics' instead. A brief classification of the special sciences would bring them under the following main heads: I., ethics; II., economics; III., politics, and IV., sociology. There should be a thorough classification and an orderly arrangement of the social sciences in each university. This would give a pedagogical as well as a scientific unity to the work.

Another very important condition noticeable in American universities is a tendency toward the applied sciences, or a tendency to study the facts of human society more and to engage in less speculation about them. In political economy, for instance, investigators and instructors dwelt almost entirely on the theories and principles of the subject. Now they are recognizing that human society is a laboratory of economics and sociology and they are inclined to do laboratory work. It is somewhat different in the study of sociology, for being a very young science it is yet passing through the period of controversy, speculation and theory. An investigation of the courses presented in fifteen of the leading universities of the West, classified as nearly as could be under theoretical and applied sciences, shows that in economics the number of applied is twice as many as the number dealing in pure theory, while in sociology the ratio of theoretical to practical is that of three to one. Economics, then, is tending toward the status of a natural science based upon classified phenomena.

There is a tendency for instruction in the social sciences to fit people for the practical affairs of life. Some of the universities have gone so far as to establish schools for commercial education, especially for the fitting of students for the business world. While many of these schools or courses are rather crude or padded, they strongly indicate the trend of economic study. The time will come when men will be prepared for the business world just as definitely as they are now prepared for law, medicine, engineering or pedagogy. In the same manner the study of politics will prepare individuals for the political administration of affairs. Sociology very early began to prepare experts for the administration of charitable and correctional affairs, and this is what ought to have occurred many years ago in the study of the social sciences.

While one should not ignore the value of the study of theory or of principles, years of time have been wasted over the fine-spun theories of wages, interest, rent, value, etc., which might have been used profitably in finding out the actual conditions of human

society, bringing students in touch with the same, and thus improving these conditions.

Politicians and business men have always pointed to the economist as a speculative dreamer, and we must admit that in the past there have been sufficient grounds for such accusation. But he is rapidly emerging into a clear-headed thinker on practical affairs. And just in proportion as he demonstrates this ability he is recognized by the business and political world.

*Public Purposes for which Taxation is Justifiable**: Allen Ripley Foote, State Chamber of Commerce, Columbus, Ohio.

Taxation for absolutely necessary purposes includes legislation, administration and the judicial activities of government. The limitations of legislative powers appear in making provision for educational, sanitary, charitable and police functions.

Both custom and law have settled in quite a definite way what are necessary public purposes in behalf of these functions. But by the arts of sophistry there has appeared the claim that an authorization to perform a function implies an authorization to do whatever may be necessary to the proper performance of the function. Take the function of education to illustrate. To teach children teachers must be employed. They must have houses in which to teach. They must have books and blackboards. Materials of many kinds must be used to construct the houses. Other materials must be used to furnish them, keep them clean and warm. Does it follow that since all of these things are necessary for the proper performance of the educational function that it is justifiable for the government to raise money by taxation for the purpose of making brick, cutting lumber, making glass, making hardware, operating coal mines, equipping and operating printing and book-binding establishments, etc.? We think not. In all the government does there is a fundamental principle that needs affirming with emphatic distinctness, the application of which will correctly determine the limitation that should be placed upon legislative power in declaring what is a necessary public purpose for which taxation is justifiable. *Every function that is commercial should be performed by private enterprise.*

Everything the government may require for the performance of its functions, that is in character identical with a service that is being performed by the people for each other in their industrial vocations, should be obtained by the government by contract with private persons, firms and corporations engaged in supplying each service for private use. This will prevent the government from monopolizing any private industry, or from withdrawing the public demand from the general market. Under the correct application of this principle the government will continue to construct its buildings by contract, to buy books, supplies and coal. It will continue to contract for the transportation of mails, the lighting of streets and the transmission of intelligence. A correct application of this principle will prevent the encroachment of governments upon the domain of private enterprise, industry and commerce. Every such encroachment is a perversion of government from the fundamental purpose for which it is instituted, the promotion of the general welfare. The need of an emphatic declaration of this principle is clearly apparent when account is taken of the efforts being made in this country, mostly for purposes of political patronage and prestige, to embark municipalities in undertakings that hitherto have been conducted by private enterprise. The need of constitutional limitations on legislative power is shown

* Title of paper read by Mr. Frederick N. Judson (no copy available) and discussed by Mr. Foote.

by an opinion rendered by Judge Holmes, now of the United States Supreme Court, when requested by the General Court of Massachusetts to interpret its powers in these respects. This opinion is quoted in Judson's 'Taxation' (1903), page 426, footnote 1, as follows:

"I am of the opinion that when money is taken to enable a public body to offer to the public without discrimination an article of necessity, the purpose is no less public when the article is wood or coal than when it is water or gas or electricity or education, to say nothing of cases like the support of paupers or the taking of lands for railroads or public markets. I see no ground for denying the power of the legislature to enact the laws mentioned in the question. The need or expediency of such legislation is not for us to consider."

*Services of Commercial Organizations in the Social and Economic Development of Cities:* WILLIAM FLEWELLYN SAUNDERS, Secretary Business Men's League, St. Louis, Mo.

Of these organizations there are nearly a thousand in the United States. The high-grade modern business organizations, through the volunteer service of their officers and members and the paid work of their secretaries and experts, are doing work which is systematic, thorough and of great value to the purposes of science. Their fundamental usefulness is in preventing the deplorable waste of fine individual power that would occur without them, either by the dissipation of energy through lack of organization or by the friction arising from the exertion of the force along different lines of individuals having the same general purpose. They organize and systematize commercial experiences; they reduce to uniformity the variety of business practises; they apply accepted principles of trade to local conditions; they collect statistics; they promote beneficial legislation and prevent harmful legislation; they prevent litigation and waste of community energy; they mold public opinion on economic questions; they generally develop the associative efficiency of citizenship.

No commercial organization could enter practical politics further than influencing legislation, without great injury to its usefulness as a business organization, and it should lay stress upon the necessity of these organizations confining themselves to commercial work.

*Some Recent Developments in Representative Government:* GEORGE H. SHIBLEY, Bureau of Economic Research, Washington, D. C.

The referendum and initiative are systems whereby the people possess a right to a direct vote on legislative questions. Far-reaching results are observed by those who for years have been studying the workings of the system in Switzerland and in this country. The system is well established in several countries, is being rapidly extended, with scarcely a reversion, then only temporarily, thus demonstrating that it is part of the evolutionary process—a world tendency.

Where the people take to themselves the right to a direct ballot, the results are exceedingly important. The final power is in the people through the right to a direct ballot, by means of the optional referendum and direct initiative. It follows that the party machine or boss can no longer enact legislation. The elected representatives simply recommend. This ensures the termination of legal privilege, thereby rendering it unprofitable for monopolists to invest money in politics, thus leaving the people free to nominate and elect men who really represent their interests. In short, representative government is restored and

politics becomes a life-work—a profession, and of the highest order.

All this is seen in Switzerland where the optional referendum has existed in federal affairs for twenty-nine years, and the direct initiative since 1891.

The striking changes which this system effects are seen most clearly in the executive department of the Swiss government. The final power being in the people, has freed the heads of departments from subservience to the instructions of a party convention. Stated another way, through the optional referendum each public question goes to the people *after* it has been considered by the heads of departments and by congress, *thus leaving these officials free to recommend whatever their best judgment dictates*. They are more independent, and probably more effective, than are the officials in our mammoth private corporations, for these heads of departments are absolutely dependent for their positions on the autocratic general manager, who is a changing factor. Not so in the Swiss government. The expert heads of departments are continued in office from term to term. For the past thirty years not a member of the Swiss cabinet has been obliged to retire. Yet there is no fossilism, for changes can be made by congress, and the subordinate officers, being more independent than in private corporations and subject to promotion for ability, propose changes. Uniform accounting opens up the keenest kind of competition.

In the general field of legislation there is absolutely no corruption under the referendum and initiative, owing to the final power in the people, and as the legislators represent the people's interests, scarcely a bill is ordered to a vote of the people. In South Dakota and Oregon not a bill has yet been referred.

The order of development in systems of government is from one-man power to party government; which in the course of centuries becomes thoroughly autocratic and is the political basis of the trusts and other forms of industrial monopoly. The next higher system is the transfer of final legislative power from the party machine to the people. It is the people's rule in place of trust rule. But in framing the legislation the people act through representatives, who are uninstructed, and thereby the highest and best forms of legislation are proposed to the people, who usually accept these bills without a direct vote.

*Wall Street and the Country:* Charles A. Conant, Treasurer, Morton Trust Company, New York. (*Atlantic Monthly*, February, 1904.)

What is the meaning of the recent flotation of industrial enterprises in Wall Street and their significance in the economic development of the country? The offer of new financial projects is the natural result of the great fund of saved capital seeking investment, and the merits of new methods of investment must be determined by the question whether they survive the tests of time and competition. Only those can survive which have in them real elements of benefit to the community. In so far as methods of investment are diversified there is greater inducement to capital to enter the market and to place itself at the disposition of far-sighted men for productive use. Speaking of such forms of organization as the security-holding company and the voting trust and of the ultimate result of such developments, the system of the security-holding company permits far-sighted men, for instance, who are willing to postpone present dividends to future wealth, to study the needs of a growing community, and to promote its growth by building traction lines in advance of the public demand instead of waiting for such a demand to become imperative. It enables

the managers of a great trunk line to put an end to transfers of passengers at state boundaries and local terminals, and to run the palatial trains across the continent upon harmoniously adjusted schedules, which, far from being 'in restraint of trade,' have done more to promote it than all the laws for preventing combination or all the suits begun in pursuance thereof. The system of the holding company undoubtedly increases the power of the big financiers, but it enables them in many cases to go forward with far-sighted plans for meeting the certain expansion of local traffic in our imperial city, or of international traffic between the grain fields of Minnesota and the markets of Asia, which would be difficult or impossible under the old system of petty competing organizations governed by the restricted vision of some neighborhood magnate.

America has a great destiny to perform in the industrial development of the world. She can perform it only by applying to every part of the machinery of production, transportation and exchange the principle of the greatest economy of effort to obtain the greatest sum of results. The opportunity for every man to rise by his talents from the lowest to the highest place, the right to reap and hold the rewards of one's labor without excessive taxation or vexatious visitation, the privilege of transferring property on the stock exchanges without the fetters imposed on such transactions in Europe, and the freedom to extend new methods of economy and combination in trade and finance across the continent, untrammeled by local tariffs and state boundaries, are among the weapons which give our country its great advantages in dealing with older competitors.

The new methods and the new projects are going through the test of fire to-day, and some of them are being consumed. The tests which weeded out the badly organized and incompetent of the early stock companies, which drove to the wall the 'wildcat' banks of ante-bellum days, and which wiped out dividends and stock rights in badly managed railways, are now being applied to the new forms of organization which have been the growth of the past decade. But the stronger and better organized of these new corporations are likely to meet these trials without disaster or to modify their methods to conform to the teachings of experience, until there remains to the financial world a valuable residuum of new methods for giving flexibility to capital and promoting its transfer promptly and efficiently from the industries where it is not needed to those where it will render its highest service.

*Social and Economic Significance of Street Railway Traffic in Cities:* E. Dana Durand, Bureau of Corporations, Department of Commerce and Labor, Washington, D. C.

This paper embodied many of the results of the census inquiry on street railways (1902), covering a period of twelve years since 1892. In this period trackage had grown from 8,123 miles to 22,589 miles. Passengers carried were about three times the world's population. In 1902 the number of rides was 170 times the country's urban population. In some of the larger cities the number of street car rides exceeded 250 per capita annually.

Among developments cited as characteristic were the substitution of electrical power, the extension of trackage outside of city limits as suburban and interurban lines, consolidation among urban lines and improvement in street railway service generally.

The social and economic significance of these agencies appears in their capacity as distributors of population to and from centralized localities, in which industries

and mercantile activities are grouped in propinquity. The street railways make possible the centralization of the retail trade, and widen the range of recreation and amusement of most people. Yet they have not reached their limits of usefulness to the artisan and the well-to-do. Too much of the time of these users is consumed on street railways and the charge is as yet too high, the average cost of carrying a passenger in the United States being 2.9 cents, not counting profits.

*Discussions.* The following participated in the discussion of one or more of the above papers: Lee Meriwether, St. Louis; W. M. Bryant, St. Louis High School; J. H. Scarborough, Warrensburg (Mo.) Normal School; Joseph A. Wright, St. Louis; Frederick N. Crunden, St. Louis; Carroll D. Wright, Washington, D. C.; William H. Lynch, Mountain Grove, Mo.

John Franklin Crowell,
*Secretary.*

Washington, D. C.

## THE ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA.

The fifth meeting of this society was held in St. Louis, Mo., during convocation week, in affiliation with the American Association for the Advancement of Science. All the sessions were held at the Central High School, where rooms were occupied conjointly with Section A.

The first session of the society was held on Tuesday afternoon, December 29, at which officers were nominated to be voted for at the annual election the next day.

On Wednesday morning a joint session was held with Section A, for the reading of papers, and on Wednesday afternoon the reading of papers was finished and the annual election of officers held.

The members of the society were served lunch at the High School by the local committee on both Tuesday and Wednesday at noon.

The meeting was the smallest ever held by the society, there being less than twenty members present. Ten new members were elected.

The officers elected were:

For 1904.

*President*—Simon Newcomb.

*First Vice-President*—Geo. E. Hale.

*Second Vice-President*—W. W. Campbell.

*Treasurer*—C. L. Doolittle.

For 1904–5.

*Councilors*—E. C. Pickering, R. S. Woodward.

Geo. C. Comstock and W. S. Eichelberger were elected members of the Council of the American Association for the Advancement of Science from the Astronomical and Astrophysical Society of America.

### PAPERS PRESENTED.

G. W. Hough: 'The Prediction of Occultations of Stars by the Moon.'

W. W. Campbell: 'The D. O. Mills Expedition.'

G. C. Comstock: 'The Sun's Motion Relative to a Group of Faint Stars.'

F. W. Very: 'The Absorption of Solar Radiation by the Sun's Atmosphere.'

Sebastian Albrecht: 'Borelly's Comet.'

W. S. Eichelberger: 'The Pivots of the nine-inch Transit Circle of the U. S. Naval Observatory.'

M. S. Brennan: 'A Short Sketch of the Progress of Astronomy in the United States.'

H. C. Wilson: 'The Eros Parallax Photographs at the Goodsell Observatory.'

### ABSTRACTS OF PAPERS.

*The D. O. Mills, Expedition:* W. W. Campbell.

The observing station of the D. O. Mills expedition from the Lick Observatory to the Southern Hemisphere was completed in October. It is located on the summit of San Cristobal in the northeastern suburbs of Santiago, Chile. Its elevation above the city is about 950 feet, the altitude of Santiago above sea level being 1,800 feet. The distance from the center of the city is about two miles.

The expedition is in charge of acting as-

tronomer W. H. Wright, who is assisted by Dr. H. K. Palmer.

The unfortunate delays encountered in completing the mirrors for the reflecting telescope made it unavoidable that the expedition should reach Chile at the beginning of the southern winter—the rainy season. San Cristobal was selected as the site early in June. The expedition reached Chile just a few days before the breaking out of very serious labor troubles. This and the storms of winter made the construction of the observatory on the summit one of considerable difficulty. The requirements for erecting the Warner and Swasey steel dome, the reflecting telescope, the electric power line from the valley to the summit, etc., could not be met by skilled labor obtainable in Chile, and the astronomers were called upon to supply this almost entirely themselves.

Up to October 9 spectrograms had been secured for determining the speeds of twenty stars, and ere this the number is undoubtedly much greater. At the time of writing, photographs of the dome, office building and general surroundings have not been received.

The completion of the extensive installation in the four winter months, in spite of lack of skilled assistance and the frequent interruptions by storms, together with the securing of a considerable number of spectrograms, is sufficient testimony that numerous and valuable results will be secured in the time assigned for the work.

*The Sun's Motion Relative to a Group of Faint Stars:* George C. Comstock.

A year ago the author presented to this society a set of proper motions of faint stars (ninth to twelfth magnitude, distributed throughout the twenty-four hours of right ascension) determined from micrometric observations extending over a period of about half a century. During the past year the author derived from these proper motions a determination of the direction and magnitude of the sun's motion, using Airy's method for the formation of the necessary equations. This method requires that some assumption shall be made with regard to the distance of each star employed, and for this purpose the author used an extrapolation of Kapteyn's formula, which represents this distance as a function of the proper motion and stellar magnitude.

The author has thus derived from absolutely new data, no one of the proper motions employed having entered into any previous investigation, the following coordinates of the apex of the solar motion:

$$\text{R. A.} = 297°, \quad \text{Dec.} = +28°.$$

The mean result of previous determinations from brighter stars is

$$\text{R. A.} = 275°, \quad \text{Dec.} = +30°.$$

The present solution furnishes as the linear velocity of the sun's motion 4.8 radii of the earth's orbit per annum, which, compared with Campbell's spectroscopic result, 4.2 radii per annum, indicates that the assumed parallaxes of the stars are not greatly in error. Adjusting the assumed distances so that the resulting solar velocity shall agree with the spectroscopic determination, the author finds for the average parallax of 67 stars included between the ninth and twelfth magnitudes, $\pi = 0''.0051$.

This number, 67 stars, represents the entire amount of data at the author's disposal, no proper motion having been rejected in the discussion, but it is doubtless too small a basis for a determination of the elements of the solar motion and, at least provisionally, the author prefers to interpret the results noted above, as evidence that the proper motions obtained for these faint stars are real quantities and that the methods employed for their derivation may with advantage receive wider

application. The author has now in hand a similar determination of proper motions of all stars fainter than the eighth magnitude for which suitable data can be obtained from the earlier double star observations of the Struves.

*Photographs of Comet 1903 c (Borelly):* SEBASTIAN ALBRECHT.

This paper gave a preliminary account of results obtained from thirty-seven photographs of the comet taken at the Lick Observatory. The photographs show that the comet had two distinct types of tails—one very much curved and short, never much exceeding a degree and a half in length, the other long, and in its general direction straight. Measures of the long tail show that its average lag behind the radius vector was less than two degrees.

The period from the 22d to the 26th of July was one of unusual activity in the comet. The plates of July 23, 24 and 26 show detached portions of the main tail, indicating changes in the emission of cometary matter from the head. From a comparison of the Lick plate of July 24 with two plates of the same date taken at the Yerkes Observatory and one taken at Nanterre, an average recession from the head of thirty-five miles per second was obtained for a detached section of the main tail. This is equivalent to thirteen miles per second relative to the sun.

The paper was accompanied by slides showing the principal features of the comet.

A more complete account of results will be published in a Bulletin of the Lick Observatory.

*The Eros Parallax Photographs at the Goodsell Observatory:* H. C. WILSON.

Some of the results of the measurements of photographs taken with the eight-inch photographic telescope at the Goodsell Observatory were exhibited. A rough solution of the equations derived from the best situated plates gives for the solar parallax 8″.799. Similar equations from the published results from photographs taken at the Bordeaux and Paris Observatories give for the parallax 8″.798 and 8″.794 respectively.

W. S. EICHELBERGER,
*For the Council.*

## SCIENTIFIC BOOKS.

*L'Année psychologique. 9me Année,* 1902. Publiée par ALFRED BINET. Paris, Schleicher Frères et Cie. 1903. Pp. 666.

This ninth number of the yearly publication issued from the psychological laboratory of the Sorbonne is rendered especially notable by the clear and acute analysis which M. Binet gives of the oldest of the problems of experimental psychology. His conclusions are at variance with all the prevailing ideas concerning the measurement of the threshold for the discrimination of sensations of contact. Since Weber first introduced the problem, it has been believed, and the researches of numberless experimenters have seemed to confirm the belief, that this threshold of tactile sensibility could be definitely determined, and that it was uniformly lowered by practise. M. Binet asserts that what has been measured is not the acuteness of tactile discrimination, but a manner of judging, of interpreting; that the threshold itself practically can not be determined; and that in all probability practise does not alter its real position.

The original articles in this number, of which there are three besides that just mentioned, cover 252 pages. They are followed by 255 pages of bibliographical analyses of nearly 80 books and articles; and by the international Bibliographical Index for the year 1902. Analysis of the original articles follows.

(1) P. Malapert: 'Inquiry Concerning the Feeling of Anger in Children' (pp. 1–40). This is a presentation of the results of a questionnaire sent out in 1900 by the newly founded Société libre pour l'étude psychologique de l'enfant. The author remarks upon the ambiguity of some of the questions, the

uncertainty concerning the figures given and their interpretation, and the general difficulties attaching to this method of investigation; and then discusses his facts under three headings. I., 'General Statistics': 183 observations are given, of which 141 were on boys and 42 on girls. Children of normal intelligence, of normal height and of good health are subject to anger, in even greater proportion than those less well endowed. Paleness is a frequent characteristic of anger, as well as hyperæmia, a fact neglected by many previous observers. Secretions are augmented sometimes. Innervation of the voluntary muscles is increased, but is uncoordinated and spasmodic. Tears appear at the close of an attack in a very large proportion of cases. The malign influence of heredity is very apparent. In all but 20 per cent. of the cases the attacks of anger have diminished in violence and frequency with increase in age. II., 'Different Forms of Anger; Irascible Children': Two fundamental types of anger are distinguishable, the one defensive and the other offensive, both connected with the instinct of self-preservation. Considerable space is given to the demonstration and description of the former type, which had not been recognized by M. Ribot. Children of a pronounced irascible type show the influence of ill-health and of hereditary taint more strongly than do the others. Anger is rarely due primarily to example. III., 'Pedagogical Considerations': Hygienic measures are as important as moral ones. The method of cure must be adapted to the individual nature. It is essential that some image, idea or feeling, profoundly incorporated within the mind and awakened by the very fact of the arousal of anger, should oppose the latter and dominate it. Corporal punishment is often beneficial. The application of cold water is preferable. In general, motives of an intellectual and moral nature are best of all.

2. B. Bourdon: 'On the Possibility of Distinguishing the Sensations from the Two Eyes' (pp. 41–56). It is possible to distinguish which eye receives an impression, when the impressions received by the two eyes differ in intensity, in distinctness or in the number of details. The distinction is due to a subjective phenomenon consisting in a sensation of heaviness or constraint in the eye which receives the impression less strong, less clear or less rich in details, and in a feeling of lightness or of facility in the other eye. The author believes, contrary to the opinion of Brückner and Brücke, that these feelings have a peripheral origin, being due probably to sensations from the muscles or tendons of the eye. Feebleness of retinal excitations leads to a low degree of innervation of eye muscles, involving a greater degree of effort in fixating, hence a feeling of heaviness or constraint. An objective phenomenon, consisting in a shadow accompanying the luminous point, sometimes appears. It can be shown that this it not due to excess of convergence when both eyes view the point, as has been surmised, but that it is closely related to the subjective phenomenon.

3. A. Binet: 'Writing during States of Artificial Excitation produced by Work of a Graphic Nature' (pp. 57–78). The author had previously observed in experiments on hysterical patients that in states of excitation writing became larger and its lines thicker; and in tests on school children that marks made in crossing out certain letters from a printed page became longer, thicker and more inclined when the task was rendered more difficult by habituating them to one set of letters and then giving them another group to cross out. He now tries a series of experiments on normal persons, in which a phrase is first written correctly and then rewritten with the vowels omitted or with other vowels substituted for the correct ones. The change from the relatively mechanical act of normal writing to a task involving a greater degree of attention and effort causes the letters to be written larger, better and often detached from their neighbors. The fact is accounted for probably by a more vivid representation of the letters, by a desire to make the incorrectly written letters legible, and especially by an attendant diffuse excitation of the movements of writing.

4–9. M. Binet divides his discussion on the 'Measurement of Tactile Sensitivity' into six separate articles (pp. 79–252). They all to-

gether, however, form a unitary paper, and it will be more convenient to analyze them together. The primary object of the research is an investigation into the possibility of any true measurement of tactile sensitivity.

(*a*) *Introductory Discussion; Methods.*—The different meanings of the term sensitivity are discussed. Much space is given to an account of Weber's researches, a little to that of his successors. Tawney's recent analysis of the Vexirfehler (mistaking of one point for two) is very significant, and really throws doubt on the very possibility of determining a threshold. There have been grave errors of method in all previous researches. The æsthesiometer should be one capable of exercising a known and equal pressure on both points stimulated; of stimulating them simultaneously, or, in case simultaneity is not attained, of registering the fact; and of regulating and recording the rapidity of application of the stimuli. The author describes such an instrument. The method of minimal changes is faulty in that it introduces suggestion strongly and gives the subject too slow an adaptation to the difference between the feelings attending small and large distances between the points. The threshold given by the method of right and wrong cases is a mere convention. A mixed method, that of irregular variations, is preferable. It consists in arranging a series of minimal differences, but applying them in irregular yet uniformly determined order. There is a serious disadvantage in employing as subjects laboratory students exclusively. Most important of all is the giving of full psychological indications. It is necessary to take account of the subject's degree of acquaintance with æsthesiometry, and of everything that is said and done which has any relation to the study of tactile sensitivity. It is a mistake to confine the responses of the subject to the simple words *one* and *two*, and when he is doubtful, to make him guess or to count the doubtful cases half to the correct and half to the incorrect replies. A long and minute analysis of everything that is felt should be exacted, since the states of consciousness are very complex and variable. It is essential to guard against distraction and to recognize it when it occurs; this can, perhaps, be accomplished best by requiring the subject to estimate the distances between the points. This procedure has the further advantage of furnishing a control as to the correctness of the replies concerning the number of the contacts. The author quotes frequently from his records of every word that was spoken during his sittings and of all facts that might have any possible bearing upon them, and the insights gained thereby into the intricacies of the conscious processes and into the influence of suggestions of all sorts, revealing facts to which a bare enumeration of numerical results would have given no clue, amply justify his insistence on the essential importance of such records.

(*b*) *The Simplists.*—There are certain persons who make no errors for the single point (no Vexirfehler); few errors for points separated by small distances (*i. e.*, they call them almost uniformly *one*); whose threshold is obtuse and well-defined; and who after practise lose their exact perception of the single point and begin to make mistakes. These the author calls '*les simplistes.*' Now Clavière has shown that between the definite sensation of a single point ($A$) and that of two distinct points ($C$) there exists a series of intermediate sensations ($B$) of a single contact of varying thickness. The simplists are those who interpret sensations $B$ as meaning a single contact, whether or not they know that all the stimulating points are of the same thickness. The author found such among school children, who were informed in advance that only one or two stimulating points were to be used and that the number of stimulating points felt was the information desired of the subject; and among adults to whom absolutely no preliminary instructions were given, who knew nothing of æsthesiometry, nothing of the nature of the points used nor of the object of the experiment, and who, after a long series in which they had at first occupied themselves with considering the character of the stimulating object or with the thought of possible painful sensations that might be inflicted, arrived spontaneously at the idea of indicating the number of contacts that were felt. The ab-

sence of preliminary explanation or its exact nature when given has a decisive influence on the character of the replies. The threshold for the back of the hand lies between 1 and 2 cm., and this is the same as the threshold for the difference between sensations *B* and *C*, for persons who deliberately seek to make this distinction. Continued practise tends to introduce Vexirfehler—to make interpreters out of the simplists; and the difference between the more and the less intelligent subjects, at first very marked—the intelligent having a lower threshold and being more subject to the Vexirfehler—tends to diminish. It is interpretation of the sensations, especially those of class *B*, and not improvement in attention or a real lowering of the threshold, that explains these effects of practise.

(*c*) *The Results of Distraction of Attention.*—Distraction may occur when attention is strongly directed elsewhere, or when there is difficulty in fixing the attention at all. The usual method of producing it consists in having the subject execute two tasks at once. When this is tried, the resulting mental states may vary enormously in different persons: there may be an easy and rapid alternation of attention between the two tasks, and thus no distraction; or an irregular alternation, with many errors and confusions; or a fixation in one direction, in which case the second task is suspended or becomes automatic. The author had his subjects carry out long additions aloud, and made contacts when the effort of attention to the figures, as clearly indicated by the voice, was greatest. Cases where attention alternated, going actually to the contacts when they were made, without distraction, could be easily distinguished from those where true distraction occurred, and presented no differences from the normal results. Investigations were made also of cases where distraction occurred as a result of mental revery, and on account of congenital defect in backward children. The effect of distraction is to produce a systematization of the replies, showing itself in an automatic repetition of the same reply, either 'one' or 'two'; or to produce replies that are due wholly to chance. The former effect, systematization, probably characterizes distraction with fixed attention; the latter is produced during distraction with mobile attention, due either to exterior causes or to congenital weakness.

(*d*) *The Interpreters.*—The author had his own tactile sensitivity tested, adopting two mental attitudes: in the one he answered 'two' only when he was certain that he felt two distinct contacts, 'one' in all doubtful cases; in the other he sought to make an interpretation for the doubtful cases, to determine whether the sensations of class *B* were occasioned by one point or two. In the latter case he obtained a lower threshold and more numerous errors for the single contact. One of his subjects exhibited in early trials a threshold of 1.5 cm.; a year later, one of 0.5 cm., but had meanwhile become fully acquainted with the processes and results of æsthesiometry, and this fact alone accounted for the difference. In general, the interpreters, who form the majority of intelligent adults, and thus of the subjects who have been employed in researches in æsthesiometry, are characterized (1) by a lower threshold for the 'double sensation,' which signifies not a greater degree of tactile acuteness, but merely a difference of judgment, of mental attitude; and (2) by a larger number of errors for the single contact. There are very many types of interpreters—sceptical, deliberate, unconscious, etc.—of which the author describes several. True hyperæsthesia may exist, and a probable case is described. It reveals itself not merely by the ambiguous apparent lowering of the threshold, which is usually only apparent, but also by an increase in the delicacy with which the distance separating the two points can be estimated for distances lying ordinarily below the threshold.

(*e*) *Influence of Practise and Suggestion on the Position of the Threshold.*—Transform a simplist into an interpreter, and you have an apparent lowering of the threshold. The transformation may take place spontaneously, or it may be due to a suggestion, to seeing or touching the apparatus, to a knowledge that all the points are of equal thickness, to observing that two points very near together give a sensation of thickness, to an expecta-

tion that the threshold will be lowered, to a fear of making errors, to a reprimand, etc. When such influences are lacking, practise has not been found, in the experience of the author, to lower the threshold, and his results agree in this respect with those of Tawney.

(*f*) *The Threshold of Double Contact can not be Determined Scientifically.*—For a simplist there is a determinable threshold. But every simplist is a latent interpreter. The determination of the threshold is practically impossible. It varies from moment to moment, and the more one seeks it the less he finds it; and it depends so strictly on the manner of interpreting the sensations, even in the cases where it appears to have a definite position, that one can not be sure that it expresses the degree of acuteness of the organ. Even if all persons had exactly the same degree of sensitivity, apparent differences would appear.

This research is certainly of the greatest value, and no future investigation in æsthesiometry can neglect the facts that it establishes. It seems legitimate, however, to question whether the author's final conclusion is fully justifiable. May it not be possible to make simplists of all one's subjects? To determine the threshold between sensations *B* and *C*, and thus to secure valuable information concerning the relative sensitivity of different regions of the body, of different persons and of the same person at different times and under various conditions?

E. B. Delabarre.

Brown University.

*Traité des Variations des Os du Crane de l'Homme, et de leur Signification au point de vue de l'Anthropologie Zoologique.* Par M. le Dr. Le Double. 118 Dessins dans le texte. Paris, Vigot Frères. 1903.

A volume of four hundred pages and all on the variations of the cranial bones! Be it noted, moreover, that the word 'cranial' is used in the strict sense, and that, therefore, the facial bones are not included. Ponderous as the work may seem, it is one that will be warmly welcomed by anatomists. It will be of great value not only to those devoted to human anatomy, but to all interested in vertebrate morphology. We are glad to understand that the author intends to continue the study of the variations of the human skeleton and that we may expect next a treatise on the facial bones. His method is that pursued in his treatise on muscular variations, which is already a classic. Side lights from embryology and comparative anatomy are thrown on the questions, while the various and often contradictory views of authors are discussed. It is natural enough that the size of this work should astonish outsiders; yet even anatomists will be surprised at the number of points of variation which present themselves.

There is no possibility of reviewing such a work in detail; but let us mention a few of the points of interest in a single bone in order to show how extensive is its scope. Let us take the first bone, the occipital. We must take up the story of the development of the squamous portion, the difference between the supra-occipital and the epactal bones, the former of which is that part which develops in membrane, while the latter is merely a wormian bone, or several together. On the outside there is the torus and the very rare median crest. On the inside are the endless varieties of arrangement of the venous sinuses (which the author attempts to classify), the torcular fossa, and the middle cerebellar fossa. Here as elsewhere the author is very severe on Lombroso and his school, who, as is well known, make much of the latter fossa as a criminal feature. He exclaims: "Must we consider Scarpa a madman or a criminal because his occipital, like that of Charlotte Corday, had a vermian fossa? If a defect in the formation of the skull or of the brain is an index of mental inferiority or of a tendency to crime, how happens it that Dante and Pericles had asymmetrical skulls (with great development of the parietal), that Kant had an interparietal bone, Volta a metopic suture, Byron, Humboldt and Meckel premature closure of sutures, and Bichat one hemisphere much smaller than the other?" For our part, while we have no wish to minimize the absurdities that the followers of the school of criminal anthropology have been guilty of,

we think that the strength of their position is that the occurrence of many anomalies in the same individual, and especially the occurrence of multiple anomalies in many members of the same family, may fairly be considered marks of degeneration; that in short there is a core of truth in the system, hampered as it is by errors. This in parenthesis. The author then goes on to discuss the various theories to account for the presence of the fossa. This in turn brings up the significance of Kerkring's ossicle, which Le Double declines to consider as representing a part of the proatlas. Here we are once more in the midst of deep questions of embryology and comparative anatomy, and yet we have not finished the squamous portion alone. Later comes a discussion of how many segments the basi-occipital may represent, and whether a subdivision of the anterior condyloid foramen into two, three or even four, results from anything more abstruse than the quasi-accidental ossification of strands of fibrous tissue. There is, as every one knows, much that is interesting in the condyloid region. We could have wished that more had been said of the fusion of the atlas and occiput, but the consideration of this phenomenon was probably beyond the plan of this volume. We must not forget to mention the interesting peculiarities of the inferior surface of the basi-occipital, nor the minute canals sometimes found in its cerebral side.

This may suffice to give some idea of the thoroughness of the work. We must, however, refer the reader to the question of the variations of the pterion, for it serves as an introduction to the author's views. Referring to the process from the squamous portion of the temporal which occasionally reaches the frontal, he writes as follows: "In accord with Gruber, Calori, Virchow, Broca, etc., and in opposition to Anoutchine, Ranke and Schwalbe, I persist in considering the frontal process of the temporal an animal analogy (theromorphie). It does not seem to me necessary, in order to affirm its reversive nature, that this should be the normal arrangement in all the simians. It occurs in a large number of them and in many other animals, which seems to me sufficient; especially as in man it occurs most frequently in what are held the lower races." What makes this announcement doubly interesting is that Professor Le Double is not one of those who call every representation of a condition normal in some animal a reversion. This was one of the mistakes of the cruder days of evolution. On the contrary, he maintains, as we have, that similarity of certain parts is no proof of descent. This is true both when we deal with structures that are normal in a species and when we deal with such as appear exceptionally in individuals. What has long been a crucial point in our mind is whether we are justified in calling a peculiarity a reversion unless we can point out at least a plausible line of descent which shall lead us back to it, and which, moreover, shall not be at variance with the pedigree necessary to account in the same way for other anomalies. To say, as some do, that there is no way of tracing by descent some particular feature through the mammalia and that, therefore, we must call its occasional appearance a reversion to something still earlier is simply to beg the question. If what we have suggested be demanded, it seems that, at present at least, the difficulties presented by the theory of reversion are insuperable. Professor Le Double, judging from the above quotation, would hardly think such a demand justifiable. None the less he very judiciously recognizes other causes.

We do not write, however, for the purpose of discussion. Our object is instead to bring an excellent book to the notice of those interested in the subject. Had it no other merit than that of bringing together the observations that have been made in the last generation, it would be indispensable to anatomists who wish to study the deeper problems.

Thomas Dwight.

Harvard Medical School.

## SCIENTIFIC JOURNALS AND ARTICLES.

*The Botanical Gazette* for January contains the following articles: 'A Morphological Study of *Elodea canadensis*,' by R. B. Wylie, brings out the general facts in regard to floral

development, the growth of the gametophytes, pollination and fertilization. Pollination is largely dependent upon the surface film of water. The functionless pollen tubes swell up into 'cystoids' in the ovarian cavity. These enlargements contain the male structures, still showing themselves as distinct cells instead of nuclei only. Double fertilization occurs and the oospore divides before the endosperm nucleus.—A paper on the 'Chemotropism of Roots,' by F. C. Newcombe and Anna L. Rhodes, records *Lupinus albus* roots as positively chemotropic toward disodium phosphate, no concentration of the salt producing a negative curve. Roots will bend into a solution strong enough to kill them. There is no evidence of osmotropism. Roots of *Cucurbita pepo* exhibit a general indifference to chemicals, showing no chemotropism even toward disodium phosphate.—'A Botanical Survey of the Huron River Valley,' by L. H. Weld, forms a second contribution to the botanical survey of this region undertaken under the direction of Professor Spalding. The paper gives detailed accounts of the soil and vegetation. The author's plan has been to give exact data, so that a comparative study may be made in the future by himself or others. Vegetation is considered largely from the dynamic standpoint.—'Southwestern Plants,' by L. N. Goodding, is a paper describing a number of new species, chiefly from southern Nevada and Utah.—W. C. Coker publishes a series of figures of the sprouting spores of *Equisetum*, showing great variation, and also describes spore distribution in liverworts.—J. B. Farmer explains his views of the quadripolar spindle in the Hepaticæ, in view of the fact that several late papers seemed to attack it.

The contents of *The Journal of Comparative Neurology* for December are as follows:

O. P. Jenkins and A. J. Carlson: 'The Rate of the Nervous Impulse in the Ventral Nerve-Cord of Certain Worms.'

O. S. Strong: 'Notes on the Technique of Weigert's Method for Staining Medullated Nerve Fibers.'

C. Judson Herrick: 'The Doctrine of Nerve Components and some of its Applications.'

B. F. Kingsbury: 'Columella Auris and Nervus Facialis in the Urodela.'

Editorials and reviews.

A monthly journal for teachers of mathematics, entitled 'School Mathematics,' edited by Messrs. George W. Myers and C. E. Lineberger has begun publication. It is a continuation of the mathematical supplement of 'School Science.'

Dr. Toulouse has become editor of the *Revue Scientifique*, the French weekly journal whose scope most nearly corresponds with that of *Nature* and of Science. Dr. Toulouse is director of the laboratory of experimental psychology at the Paris Ecole des Hautes Etudes and editor of the 'International Library of Experimental Psychology,' now being published in fifty volumes.

It is said that there will shortly be published at Paris a monthly journal devoted to radium and called *Le radium.*

## SOCIETIES AND ACADEMIES.

### THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 149th meeting was held on January 13, 1904. The following papers were presented in the regular program.

*The Work of the Strassburg Seismological Congress:* H. F. Reid.

Professor Reid, who was the official delegate from the United States, stated that the congress was held in response to a call from the German government to discuss the organization of an international seismological association. The congress was attended by official delegates from nineteen countries, and two others were unofficially represented.

The conference resulted in the determination of the form of an international seismological association, which will be submitted to all civilized nations of the world by the German government. The most important clauses of the constitution are as follows:

"The object of the association is the study of seismological problems, whose solution is only possible by the cooperation of many observatories in all parts of the world. The principal means of attaining this object are: (*a*) Observations according to common principles; (*b*) experiments on problems of special importance; (*c*) foundation and support of

seismological observatories in countries which need the pecuniary aid of the association; (*d*) organization of a central bureau for the collection, study, editing and publication of the reports sent from various countries.

"The members of the association shall be the nations which may join. They are to make the following annual contributions through the department of state at Berlin: (*a*) Nations with a population of less than five million, $100; (*b*) nations with a population between five and ten million, $200; (*c*) nations with a population between ten and twenty millions, $400; (*d*) nations with a population of more than twenty million, $800.

"The organs of the association are: (*a*) The general assembly; (*b*) the permanent commission; and (*c*) the central bureau.

"The general assembly shall consist of delegates from the nations which are members of the association, and is to meet at least once in four years. Delegates from scientific societies and other persons may be invited to attend the general assembly.

"The permanent commission shall consist of the director of the central bureau and one delegate from each nation.

"It shall elect from its own number its president, vice-president and secretary-general.

"The permanent commission shall have general control of the affairs of the association, and shall see that the resolutions of the general assembly are carried out. It shall also direct the method of expenditure of the funds of the association, which are to be used for: (*a*) Expenses of publication and administration; (*b*) salary of the secretary-general; (*c*) to subsidize theoretical work or experiments of exceptional importance which may have been ordered by the general assembly; (*d*) for the foundation and support of seismological observatories founded by the association, the observations of which are of general interest for the study of seismical phenomena.

"A financial account shall be published in the proceedings of the permanent commission.

"The central bureau shall be located at the imperial central seismological station at Strassburg, and the director of the latter shall be the director of the central bureau; the central bureau shall have the benefit of the assistants and resources of the central station.

"The central bureau shall collect the reports from the different countries, edit and publish them. The director of the central bureau shall present an annual report covering the whole work of the bureau, and shall also outline the work proposed for the following year.

"The secretary-general shall make a report to every general assembly on the work and condition of the association. He shall attend to the publication of the proceedings of the permanent commission, of the deliberations of the general assembly and of investigations undertaken by order of the association. He shall have charge of the general affairs of the association under the direction of the president of the permanent commission.

"The association shall be formed for a period of twelve years, beginning April 1, 1904. Nations which join the association may withdraw at the end of each period of four years, on giving six months' notice of their intention."

The next paper, entitled 'Experiments on the Pollution of Deep Wells in Georgia,' presented by Mr. M. L. Fuller, dealt with a practical experiment, conducted by the United States Geological Survey and the Geological Survey of Georgia, acting in cooperation, to determine the liability of contamination of the deep wells and springs in the vicinity of Quitman, Georgia, by the proposed action of that city in turning the public sewage into an underground stream through a bore hole. To test the matter the surveys mentioned inserted two tons of salt into the well into which it was proposed to turn the sewage. Samples of water were taken before the experiment to determine the normal chlorine of the waters, and at short intervals during and for some time after the experiment. On analyzing the samples it was shown that the salt had entered all of the deep wells in town, thereby demonstrating that the insertion of sewage would have contaminated all of the wells and possibly led to a dangerous epidemic.

Mr. Arthur J. Collier then presented a paper on 'The Tin Deposits of the York Region, Alaska.'

The York region occupies the western part of the Seward Peninsula, and has the form of a triangle, with Cape Prince of Wales, the most western point of the continent, at the apex, the Arctic Ocean and Bering Sea for the sides. The region has no harbor, and landings are made through the surf, but Port Clarence, a safe, deep harbor, lies twenty-five miles southeast.

The principal topographic features are the York Mountains, which occupy the southeast corner of the triangle, and the York Plateau, 200 to 600 feet high, surrounding these mountains on the south, west and north sides. Cape Mountain and Cone Hill are 'monadnocks' on this plateau, the former marking the westernmost point of land. Three sedimentary formations are recognized, forming irregular belts, which extend north and south. The York Mountains are composed of Silurian limestones. West of these is a belt of metamorphic slates of undetermined age, and beyond these is a narrow limestone belt probably of lower Carboniferous age. These sediments contain intrusive masses of granite and rhyolite, with which tin ore is associated, and greenstones which have no economic bearing.

The Lost River tin deposits are four or five miles from the coast in the York Mountains. The tin occurs in a greisen dike, about one mile long and 100 feet wide, which cuts the limestone and extends east and west. The rock consists of fluorite, calcite, quartz and lithia mica, with cassiterite, pyrite, galena, wolframite and garnet as accessory minerals. In a granite boss, south of this dike, some stannite was found.

On Cape Mountain, which is an intrusive granite boss, cassiterite, closely associated with tourmaline, has been found on the surface, at at least three distinct points. During the past year several short tunnels were driven into the mountain in search of the veins from which it was derived, but so far without success, though the granite is partially altered to greisen, and possibly carries small amounts of tin.

On Buck Creek, which lies twenty miles inland and drains into the Arctic Ocean, the ore occurs in the form of stream-tin. The alluvial deposits were exploited during the past season, and a number of tons of tin ore were mined and shipped. The stream-tin evidently came from small veins in the slates. No veins of this kind have been found in place, but specimens, showing their character, have been found in the gravels.

The placers on the Anikovik River and Buhner Creek, in which tin ore was found in 1900, have been abandoned, but all of the discoveries and developments noted date from that report.

Alfred H. Brooks,
*Secretary.*

THE CHEMICAL SOCIETY OF WASHINGTON.

The 147th regular and the 20th annual meeting of the society was held on January 14 in the Assembly Hall of the Cosmos Club.

The annual reports of the treasurer and secretary were read and the following officers elected:

*President*—Dr. E. T. Allen.

*First Vice-President*—Mr. S. S. Voorhees.

*Second Vice-President*—Mr. L. M. Tolman.

*Secretary*—Mr. Atherton Seidell.

*Treasurer*—Mr. F. P. Dewey.

*Additional members of the executive committee*—Dr. W. T. Hillebrand, Mr. L. S. Munson, Dr. E. A. Hill and Mr. Allen Wade Dow.

*Nominated to represent the Chemical Society as Vice-President in the Washington Academy of Sciences*—Dr. Frank W. Clarke.

*Representatives in the Council of the American Chemical Society*, elected November, 1903—Dr. Henry N. Stokes, Mr. S. S. Voorhees.

A special meeting of the society was held at 8 P.M., February 1, in the Chemical Lecture Hall of the Columbian University, to hear an address by Dr. Chas. B. Dudley, of Altoona, Pa., upon the 'Work of a Chemist on a Railroad.'

The speaker first briefly presented statistics of the equipment and annual expenditures of the Pennsylvania Railroad system. It appeared that up to the time of the establishment of the chemical laboratory of that railroad the supplies were bought solely upon the representation and reputation of dealers or manufacturers, but the work of the chemist has shown the necessity for critically examining all materials bought for the road.

The work of a railroad chemist divides itself into three main divisions, which are: (1) Experimental investigations to ascertain the requirements of the railroad, respecting different classes of supplies, and from such investigations the preparation of written specifications describing such requirements. The importance of this work for the future good to the road was emphasized. (2) The testing of supplies to learn if the quality of the material corresponds with that provided for by the specifications. (3) Difficulties or problems which other officers of the road, from lack either of time or of proper training, are unable to solve. A number of examples of such difficulties which came within his experience were described. The speaker concluded by assuring the young men present that the number of problems for the railroad chemist to solve was greater now than ever, and this field of work still offers very important opportunities for usefulness.

A. Seidell,
*Secretary.*

### MASSACHUSETTS INSTITUTE OF TECHNOLOGY GEOLOGICAL JOURNAL CLUB.

The club reviewed the following articles during December and the first two weeks in January:

L. T. Buell, 'The Tin Deposits of the Malay Peninsula' (*Jour. Geol.,* February-March, 1903); H. A. Buff, 'Conditions in the Pennsylvania Anthracite Region' (*Eng. and Min. Jour.,* November 28, 1903); P. M. Paine, 'The Laurentian Peneplain' (*Jour. Geol.,* October–November, 1903); J. T. Glidden, 'Lead Resources of the United States' (*Eng. and Min. Jour.,* November 28, 1903); B. L. Johnson, 'Some Montana Coal Fields' (*Am. Geologist,* December, 1903); W. L. Spalding, 'The Ore Deposits of Tonopah, Nevada' (*Eng. and Min. Jour.,* November 21, 1903); W. L. Whittemore, 'Cobalt Mining in New Caledonia' (*Eng. and Min. Jour.,* November 28, 1903); R. H. Allen, 'Gold Mining in Rhodesia' (*Eng. and Min. Jour.,* December, 10, 1903); C. H. Clapp, 'The Wisconsin Zinc Fields' (*Eng. and Min. Jour.,* December 5, 1903); W. G. Ball, 'The Quicksilver Mines in Idria' (*Eng. and Min. Jour.,* December 17, 1903); C. E. Danforth, 'Asphalt Mining and Refining in the Indian Territory' (*Eng. and Min. Jour.,* December 17, 1903); C. W. Johnston, 'The Gold Placers of Bokhara' (*Eng. and Min. Jour.,* December 24, 1903); E. Burton, 'Age of Gypsum of Central Iowa' (*Jour. Geol.,* November–December); F. S. Elliot, 'Geology of the Apache Cañon Placers' (*Eng. and Min. Jour.,* December 24, 1903); M. Rubel, 'The Anthracite Conciliation Board' (*Eng. and Min. Jour.,* December 24 and 31, 1903).

The following original papers were read:

Professor W. O. Crosby, 'The Physiographic Geology of the Gold Regions of Alaska.' The paper was illustrated by several lantern views which were taken by Professor Crosby on his recent trip through Alaska. Professor W. H. Niles, 'The Life of Joseph Le Conte'; Professor A. W. Grabau, 'Rock Classification.' Professor Grabau presented a new system of classification which should include all the different kinds of rocks. His paper was discussed with very great interest and met with general approval. G. F. Loughlin described a granite-gneiss of central Connecticut. The igneous origin of this formation was proved by Mr. Lewis Westgate (*Jour. Geol.,* Vol. VII., No. 7, October, 1899). Mr. Loughlin reviewed Mr. Westgate's paper, and spoke of the fitness of the stone for building purposes. He attributed the tendency of the stone to stain on exposure to the minute grains of pyrite and microscopic garnets which are abundant in the rock. J. Daniels spoke briefly on the methods of taking sample borings and the uses made of them.

G. F. Loughlin,
*Secretary.*

### NEW YORK ACADEMY OF SCIENCES. SECTION OF BIOLOGY.

The January meeting was held on the eleventh of the month, Professor Underwood presiding. Papers were read by Professor H. F. Osborn and Miss Adele M. Fielde.

Professor Osborn's paper, entitled 'The Classification of the Reptilia,' presented the history of the classification as follows: (1) Recognition of the Cotylosauria as the most

primitive group of reptiles, by Cope and Baur. (2) The separation of the Anomodontia, Chelonia and Sauropterygia as reptiles with a single temporal arcade, by Smith Woodward and Broom. (3) The affiliation of the Ichthyosaur with the two-arched rather than single-arched reptiles, by Baur and McGregor. (4) The recognition of *Sphenodon* as the ancestral type of the two-arched reptiles, by Baur and others. (5) Separation of the reptiles into two great groups of single-arched and two-arched types, by Smith Woodward and Broom. (6) The demonstration that reptiles are separated not only by the structure of the temporal arch but by many fundamental characters into two distinct groups, by Osborn and McGregor (1902). (7) Consequent division of the Reptilia into two subclasses Synapsida and Diapsida, by Osborn (1903). (8) The proposal of the Diaptosauria to include all of the most primitive two-arched reptiles without armature, by Osborn (1903). (9) The classification of the Reptilia according to the accompanying table (1903–4).

CLASS REPTILIA.

I. Subclass Synapsida, Osborn.
 1. Order Cotylosauria, Cope [=Pareiasauria, Seeley].
  Family Diadectidæ.
  Family Pariotichidæ.
  Family Pareiasauridæ.
 2. Superorder Anomodontia, Owen [=Theromorpha, Cope, in part].
  Order I. Theriodontia, Owen.
   Suborder I. Therocephalia.
   Suborder II. Cynodontia, Owen.
  Order II. Dicynodontia, Owen.
   Inc. Sedis.
  Order III. Placodontia, Owen.
 3. Order Sauropterygia.
  Suborder I. Simosauria, Gervais [=Nothosauria].
  Suborder II. Plesiosauria.
 4. Order Testudinata.
  Suborder I. Pleurodira.
  Suborder II. Cryptodira.
  Suborder III. Trionychia.
II. Subclass Diapsida, Osborn.
 1. Superorder Diaptosauria, Osborn.
  Order I. Procolophonia, Seeley
  Order II. Protorosauria, Seeley.
  Order III. Proganosauria, Baur.
  Order IV. Gnathodontia, Owen.
  Order V. Pelycosauria, Cope.
  Order VI. Choristodera, Cope.
  Order VII. Rhynchocephalia, Günther.
 2. Order Parasuchia, Huxley.
  Suborder I. Aëtosauria.
  Suborder II. Phytosauria.
 3. Order Ichthyosauria, Blainville, 1835 [=Ichthyopterygia, Owen, 1839].
 4. Order Crocodilia.
  Suborder I. Mesosuchia.
  Suborder II. Eusuchia.
  Suborder III. Thalattosuchia.
 5. Superorder Dinosauria, Owen.
  Order I. Theropoda, Marsh.
   Suborder I. Megalosauria [=Thecodontia, Owen].
   Suborder II. Compsognatha, Huxley.
  Order II. Opisthocœlia, Owen [=Sauropoda, Marsh].
  Order III. Ornithopoda, Cope [=Predentata, Marsh].
 6. Superorder Squamata.
  Order I. Lacertilia.
  Order II. Mosasauria.
  Order III. Ophidia.
 7. Order Pterosauria.

Miss Fielde's paper, on the 'Sense of Smell in Ants,' described her experiments with many species of these insects. Each species appears to have its distinctive odor, discernible by other ants. Within each species there are also differences of odor, dependent on the age of the colony and the age of the queen from whose eggs its inmates are produced. The ant's organs of smell are its antennæ, in which the joints are as a series of noses, each having a special function. The distal joint appreciates the nest-aura informing the ant whether it is in its own nest or in that of an enemy. The second joint discriminates between the odors of ants of the same species as itself, but of different colonies. The third joint discerns the scent of the track laid down by the ant's own feet, and enables the ant to return upon any route that has been previously traversed. The fourth and fifth joints smell the larvæ and pupæ, and the removal of these joints disables the ant from further care of the inert young. The sixth and seventh joints make known to the ant the presence of

ants of other species than her own. So many as five joints may be retained by ants whose antennæ have normally eleven or twelve joints, and these ants will live peacefully together though they be of different subfamilies. But if seven joints be retained, the ants, similarly grouped, will fight one another to the death. If ants make one another's acquaintance before they are twelve hours old they will thereafter live amicably together although they be of different species, genera or even of different subfamilies. But in three days after hatching their criterion of correct ant odor is established, and they refuse to affiliate with ants whose odor is not in accord with their standard.

M. A. Bigelow,
*Secretary.*

THE TORREY BOTANICAL CLUB.

The Torrey Botanical Club met at the New York Botanical Garden, January 27.

The first paper on the scientific program was by Dr. J. K. Small, on 'Recent Explorations in Southern Florida.' Dr. Small was accompanied on his trip by J. J. Carter, of Pennsylvania, and for a part of the time by A. A. Eaton, who paid special attention to the orchids and ferns. From Miami as a base expeditions were made in different directions. One trip was made to the northward in the direction of Ft. Worth. Four strikingly different plant formations were noted in this region: (1) Sand ridges covered with gnarled and stunted trees and shrubs mixed with cactuses with almost no grass or herbaceous vegetation, (2) low-lying moist lands covered with grass and sedges but destitute of trees and shrubs, (3) the pine lands, and (4) the hummocks filled with broad-leaved evergreens and deciduous trees. The country south of Miami is just being opened up to settlement and is still in a primitive condition. Most of the excursions were in this direction, explorations being made for a distance of forty-five miles. The region consists of low coral-limestone ridges with no appreciable soil, but still supporting a dense pine forest. The lower levels are filled with water and constitute arms of the everglades. The pine lands are interspersed with occasional small hummocks. An exceedingly interesting flora was found, and over a thousand numbers were collected, which include an unusual number of new and interesting things. So far as the collections have been studied, the plants from the hummocks show a close relationship to the Cuban flora and include a considerable number of West Indian species not heretofore known from the mainland. The pine-land plants, on the contrary, are largely endemic and include many undescribed species.

In the discussion which followed the reading of the paper it was stated that the expedition would probably add at least a hundred species to the known flora of the United States.

The second paper was by Dr. J. C. Arthur, on 'An Interesting Unpublished Work on the Fungi.' The paper will be printed in an early issue of *Torreya.*

The third paper was by Dr. N. L. Britton, on 'The Birch Trees of North America.' Recent study in arranging the dendrological exhibit in the museum has shown the necessity for a further investigation of our arborescent flora. In some genera, notably in *Fraxinus,* too many species are now recognized and some reductions will be necessary. In the birches, on the contrary, it is necessary to recognize at least four new species. One of these is in the Alleghany region, and the others are northwestern.

F. S. Earle,
*Recording Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### CONVOCATION WEEK.

The problem of cooperation and practical affiliation between the important scientific societies of the country and the American Association is one which, admittedly, is becoming each year more difficult of solution. The difficulty, moreover, is multiple and dependent on a variety of factors, rather than on one or two.

The consideration of expense, dependent partly on distance, is usually urged as the most important one, but this plea is not always sufficient. During the last convocation week it is known that many men in going to

Philadelphia spent more time and money than would have been required in going to St. Louis. The fact is, most scientific specialists will go where they expect to receive the greatest benefit, and not a few entertain the notion, apparently, that the special society with limited membership offers a better field for labor than the more democratic sections of the association. The difficulty in such cases might be obviated through the plan followed by the chemists. The American Chemical Society, which includes probably the whole of the membership of Section C, holds two meetings annually. By agreement made seven or eight years ago through committees from both organizations, one meeting of the Chemical Society is held each year in connection with that of Section C. The program of this meeting is a joint production; the officers of Section C preside through half the sessions and those from the society through the other half. This scheme has worked well from the beginning, and I have yet to discover that there is any tendency to make one of these annual meetings any more aristocratic or exclusive than the other. The plan works to maintain Section C in flourishing condition and gives a separate meeting for such chemists as may desire it, once a year.

To make any such arrangement permanently satisfactory one thing will be found necessary. The association will have to decide upon and publish its meeting places several years in advance. This will give the chemists and other special organizations an opportunity of planning properly for the intermediate or semi-annual meeting. Advance knowledge of this kind would make it possible to avoid an awkward situation like the one in which some of the societies now find themselves. The Chemical Society held a meeting in Philadelphia two years ago; other societies have just been there, and all those who are loyal to the association will expect to return there next winter. As individuals most of us would doubtless prefer to go to some place not so recently visited.

I, therefore, suggest that a committee from the association, perhaps the committee on policy, take the matter up and invite cooperation from the various societies. In this way it may be possible to prepare a program for four or five years ahead. The contingency of returning to the summer meeting, after the meetings at Philadelphia and New Orleans, of course, would have to be considered by this committee. It is not too early to begin work on such an advance program, which should be in shape for presentation at Philadelphia. Most of the interchange of views will have to be by correspondence, which consumes time.

Now, as to the continuation of the convocation week scheme. The Washington gathering was a great success for several reasons. The St. Louis convocation was not as satisfactory, and a number of factors operated to keep down the attendance. Bad weather was partly at fault, and many were doubtless kept away through the expectation of visiting St. Louis next summer. It is not fair to draw many conclusions from this occasion. For those organizations which, like the American Chemical Society, hold two meetings each year convocation week should be as convenient a time as any for the large general gathering. My personal preference would be for the last week in June, and this date, just after the commencement season, would doubtless suit most men from the schools of the west or middle west. But, on the other hand, the date is too early for men from some of the eastern schools. A September meeting is too late for some college men, and in August the temperature factor is usually against us, etc. Bringing up these points now is like threshing over old straw. I am, therefore, in favor of giving the winter meeting plan a trial long enough thoroughly to test its merits, which may require several years. In any event, I believe it is for the best interests of every scientific man in America to aid in building up and maintaining the power and influence of the association in developing lines of scientific work. The section scheme and convocation week bring us all together. Why not continue a good thing!

J. H. Long.

In regard to the question of the best organization of scientific societies, my experience

has been, if you will let me eliminate the word scientific, that the most flourishing societies are those where the governing body has been fairly permanent. By such means a stable organization and consistency of purpose are possible.

The great value to be derived from a discussion of this character is that from the various opinions presented some ideas will be offered that may be of service in improving the government of the American Association for the Advancement of Science. Therefore, I may at the outset say what every one connected with the association knows, that it has been continually experimenting, in the hopes of finding something that would give satisfaction to every one; but as that is an impossibility it should be accepted as such at the beginning. What is needed, therefore, is a consistent policy that will extend over a number of years, in order that the advantages of the existing policy may become apparent and sufficiently numerous to outweigh possible objections. For instance, it matters little to most of us whether the meetings are held in summer or during convocation week, but if they are held at one time, those who prefer the other time naturally criticize the change, and discontent is the result.

The council, which is the governing body of our association, should be a permanent organization, so far as possible, and changes should be limited to the new officers elected each year. What is needed, it seems to me, is more conservatism, that is, less disposition to change. Originally, this was provided for by making the past presidents permanent members of the council, but unless the meeting is held in some convenient place, the past presidents are apt to be conspicuous by their absence, or if they are registered at the meeting, they do not attend the council. The result has been that each year new men, many of whom are possessed of decided opinions and are unfamiliar with the traditions of the organization, have come into the council, and they have suggested innovations that seemed to offer advantages, which on experiment failed to manifest themselves. May I illustrate my point by a note that appeared in Science subsequent to the Washington meeting, written by one of the vice-presidents of the organization, who criticized the local committee for not having offered certain facilities which he deemed desirable; whereas, as a matter of fact, the local committee had distinctly made the very provision that he called for, but it was completely ignored by the visiting scientists. Had the gentleman who wrote the note been more regular in his attendance at the meetings, he naturally would have known that his wants had been anticipated, a fact that could readily have been ascertained by inquiry of the local secretary. Finally, it seems to me highly desirable that the affiliated societies should be represented on the council by men who should serve for a term of years.

In conclusion, so far as my experience is concerned, I venture the opinion that the most satisfactory form of organization is the one in which the governing body is changed each year only by a minority of its members.

Marcus Benjamin.

To the Editor of Science: The recognition by our leading universities of one week in the year as convocation week is an indication of the academic value put upon the work of our scientific and learned societies. No other cause could secure such recognition, and it behooves those who have the guidance of these societies to make the meetings worth attending.

A large attendance of those interested and competent to take a part is, I take it, next to honest work, the chief desideratum; otherwise publication would meet all reasonable demands. How to secure a good attendance, therefore, is the first question to raise. Is the first week of the new year the best time for the purpose? For most societies I assume that it is. But the Society of the College Teachers of Education, the latest affiliated group, finds itself unable to meet regularly with the American Association. In most states the state teachers' association meets during the Christmas holidays, and properly enough many of the college teachers of education are expected to be present. Attendance on two meetings within two weeks is a heavy task for the holiday time. Furthermore, the Department of Superin-

tendence of the National Educational Association meets annually in February, and many college teachers of education find it desirable to attend its meetings. Consequently the society plans to alternate between convocation week in January and the superintendents' meeting in February. It is very doubtful if the educationists could secure satisfactory attendance during convocation week unless the meetings were held in a very central location. Nevertheless, I feel that it is worth while occasionally, say every other year, to sacrifice something in order to come in touch with the other great societies. This object, however, would hardly be gained if other societies should act in the same manner, unless some agreement could be reached concerning the biennial sessions.

My suggestion is that once in two years all the societies meet in the same place, and that on alternate years the chance be given the affiliated groups to serve their various interests. The place of holding the biennial sessions should be on or near the trunk lines and have suitable hotel accommodations. In my judgment, too, much would be gained by returning biennially to the same place. It would tend to give the association a fixed home and, what seems to me of great importance, a permanent and reliable constituency.

James E. Russell.

Concerning the plan of holding our annual session in the winter and also of the conflicting interests of the association and the affiliated societies, it is perhaps too soon to give a decided opinion, but I have a strong impression that a definite plan separating the sessions of the association from those of the societies is necessary to the highest welfare of both. Unless something is done the affiliated societies will swamp the association.

My preference would be to have it generally understood that the affiliated societies make a special business of meeting during the convocation week, each one where it chooses, and that all come together in the summer, either the week before or the week after the National Educational Association, for a grand association meeting, which shall be scientific, technical and social, and where all papers will be delivered either before the general association or before the departments of the same. By such an arrangement every section would be a success, and there would be no serious conflict of interests, and the delightful social features of the association would be perhaps a prominent feature at the summer meeting.

In my judgment persons who claim membership in the American Association by virtue of membership in an affiliated society ought to pay something into the treasury of the association, or the affiliated society should pay for them. The present arrangement seems to me unfair and unjust.

At the present time the great body of people who would naturally be most interested in Section D have their special societies. Civil engineers, mechanical engineers, electrical engineers, architects and (including them all) the Society for the Promotion of Engineering Education; all these would naturally be more or less interested in the work of Section D. None of these societies are affiliated. They meet independently when they will, but they do not desire to conflict in any way with the American Association. In fact it may truthfully be said that the American Association looks at the matters which interest all engineers and teachers of engineering from a somewhat different point of view from that of the societies I have named, and consequently it has a distinct function and sphere of its own. Section D affords an opportunity for the members of all these societies to get together on a common platform.

C. M. Woodward.

### PROFESSOR METCALF'S EVOLUTION CATECHISM.

To the Editor of Science: In Science of January 8, 1904, Professor Metcalf formulates (p. 75) a series of crucial evolutionary questions. It is undoubtedly true that 'much further observation' will be necessary to decide them, to the satisfaction of everybody, but it is not less evident that we have already a vastly larger body of evolutionary facts than we have adequately interpreted. In the belief that the problem is at present one of interpretation quite as much as of observation, I

venture brief replies to Professor Metcalf's questions, premising only that these suggestions are incidental to 'A Kinetic Theory of Evolution' outlined in SCIENCE of June 21, 1901, and in subsequent papers.

*"Are there mutations which are distinct from fluctuating variations? Are fluctuating variations restricted to rather narrow limits, and are the larger variations which occur of a different sort, establishing a new mean about which a new series of fluctuating variations cluster?"* Yes; mutations or spots which appear among inbred domesticated plants and animals differ from the 'fluctuating' individual diversity of unsegregated wild types in the amplitude or abruptness of the variation, and in a more or less pronounced reproductive debility. 'Fluctuations' and mutations are extremes of the same series of phenomena, but their evolutionary significance is very different. New types are built up through the interbreeding and accumulation of genetic variations, but mutations which depend for their existence on narrow segregation do not contribute to the evolutionary progress of species.

*"Are mutations (or variations) definite or indefinite? Do they follow certain lines or do they occur in all directions?"* Variations of both kinds occur in many directions. The idea that they exactly offset each other and thus maintain a stationary average has no warrant of observation and is opposed to the calculus of probabilities. Species tend to move in *some* directions, but not in all directions (Darwin), nor in one particular direction (Naegeli).

*"If the direction of mutations (or variations) is wholly or in part predetermined, what are these predetermining factors? Are they internal (involved in the nature of the organism), or external (environmental), or both?"* They are internal, but not predetermined. Organisms of the same descent under the same conditions give diverse mutations. Of their causes in detail nothing is known; mutations are, however, *induced* by persistent inbreeding. The direction or the extent of variation may also *depend* upon external conditions. A variation in the direction of larger size would not be able to develop without adequate food.

*"Is there a tendency in mutants (or variants) to revert toward the condition of the parent stock?"* Normal genetic variations are more vigorous and prepotent than their immediate relatives, but mutations tend to 'revert' when the abnormal inbreeding is remedied by crossing.

*"Are mutants (or variants) of one sort more (or less) fertile or more (or less) vigorous when bred together than when bred with the parent stock or with mutants (or variants) of another sort?"* Sustained vigor and fertility, and evolutionary progress, as well, depend on normal interbreeding (symbasis). Mutative varieties are, in general, rendered more vigorous by crossing with less inbred stock, but often at the loss of their peculiar characters.

*"Does mutation (or variation) cause partial (or complete) segregation?"* Mutations are sometimes completely segregated by sterility, perhaps also by cytological or other malformations which prevent the resumption of interbreeding, but such abnormalities have no general evolutionary significance.

*"Are hybrids between mutants (or variants) of different sorts or between mutants (or variants) and the parent stock intermediate in character between the two parents, or do they follow wholly or chiefly one parent? If the latter, which parent is followed in the several kinds of crosses?"* Crosses between different mutants or even between similar mutants of different descent tend to 'revert' to the parental type. In crosses between mutants and their immediate and equally inbred relatives the mutant is prepotent, but individuals of the parental type may be prepotent if of a sufficiently remote line of descent. When the divergence of descent is too great or too long-standing to permit a return to the ancestral form, or when the prepotency of the mutation is balanced, as it were, by the prepotency attaching to smaller degree of inbreeding of the form with which it is crossed, there result disjunctive or 'Mendelian' hybrids.*

* Further confirmation came to hand after this letter was sent in. Professor Davenport finds

The discussion of evolution has long since passed the stage when particular facts could be used to prove general conclusions. The difficulty with the current hypotheses of evolution through selection and mutation is that while apparently supported by some facts, they are as definitely contradicted by others; a theory which can accommodate both series of phenomena has a larger basis of probability than either. From the standpoint of the kinetic theory the rejection of selection as the actuating cause or principle of evolution does not require the denial of selective adaptation. The recognition, on the other hand, that mutations are not caused by environment, does not mean that they are definitely predetermined. The abrupt and striking but more or less sterile aberrations of heredity which occur under inbreeding do not show that evolution depends upon segregation. Neither do they afford evidence against the view that evolutionary progress goes forward through the gradual accumulation of lesser and more normal variations, independent of environment, but not beyond selective influence. The kinetic theory affords the explanation, hitherto lacking, of how selection produces adaptation. It does not set stationary organisms in motion, but it may, at times, determine which variation shall most affect the direction of the motion of the species.

O. F. Cook.

Washington, D. C.,
January 14, 1904.

(Science, N. S., 19: 112, January 15, 1904) that albino mice of mixed ancestry are more prepotent or less recessive than those of pure breed, a result contrary to that which should follow under the pure-germ-cell, character-unit theories of Bateson, Wilson and Castle. The improbability of these mechanical hypotheses was already evident, however, from the fact, known since the time of Darwin, that the crossing of two 'recessive' inbred 'mutations' may bring a return to the ancestral type. The tendency to disregard older data seems to indicate that the recent DeVriesian and Mendelian mutations of terminology are prepotent in closely segregated evolutionary investigations, but the ancestral facts are still vigorous and likely to reassert themselves whenever a wider intercourse of ideas is resumed.

THE ANIMAL PARASITE SUPPOSED TO BE THE CAUSE OF YELLOW FEVER.

In Science of January 1 there appeared a letter signed H. W. Robinson, which purported to be a defense of one of the members of the working party which I arraigned in my article under the above caption in Science of October 23, 1903.

In reference to this letter I beg to state that I am not expected to give any attention to what one has to say whose knowledge of the matter is second-hand, but that I am fully prepared to defend whatever I have written in my article, whenever any of the working party answers to my arraignment of its members.

J. C. Smith.

New Orleans, La.,
January 25, 1904.

## SPECIAL ARTICLES.

### A FISH NEW TO FLORIDA WATERS.

While dredging off the coast of Florida in 1902, the steamer *Fish Hawk* collected four specimens of a fish whose occurrence in that region was most unexpected and whose known distribution is thus extended in a most interesting direction. The fish in question is the snipe-fish or bellows-fish, *Macrorhamphosus scolopax* (Linnæus), which is common in the Mediterranean and has occasionally been found as far north as the southern coast of England, inhabiting depths up to 170 fathoms. The *Fish Hawk* specimens were taken at two stations in the Gulf Stream off Key West at depths of 98 and 109 fathoms, respectively.

There is one other known occurrence of this fish in American waters, recorded by Storer in the *Proceedings of the Boston Society of Natural History* for 1857 (Vol. VI.), a specimen having been found at Provincetown, Massachusetts.

H. M. Smith.

### NOTE ON A RUBBER-PRODUCING PLANT.

Recent experiments have shown some interesting facts in regard to the products of *Picradenia odorata utilis*, Ckll., *Bulletin Colo. College Museum*, December, 1903, a plant belonging to the Compositæ and growing abundantly in the neighborhood of Buena

Vista, Colorado. Mr. F. R. Marsh, of Denver, first called my attention to the fact that the roots of one of our native plants contained rubber, and kindly supplied me with material for experiments.

The roots tested were found to contain from five to twelve per cent. of crude rubber. This product is soluble in carbon bisulphide and benzol; it burns, giving off a strong odor of rubber. Several tests were made which showed that powder made from the bark contained a much larger per cent. than that made from the whole root. The crowns, when cleaned, contained about the same per cent. as the roots; the wool-like material surrounding the crowns contained a small per cent., though it was not so elastic as that taken from the roots and crowns.

The stems and leaves contained a resin soluble in carbon bisulphide, but it was a brown inelastic mass and when burned lacked the characteristic odor of rubber. The seeds contained a resin that superficially resembled that found in the stems.

It is hoped that the occurrence of rubber in the permanent parts of this *Picradenia* and not in the parts lasting only through the season may add to our knowledge as to the use of this substance. A detailed report on the physiological structure of these roots will be made as soon as fresh material can be obtained.

WILMATTE PORTER COCKERELL.

COLORADO COLLEGE,

## BOTANICAL NOTES.

### PROGRESS IN FORESTRY INSTRUCTION.

IT is but a few years since American university professors have given serious attention to that department of botany which deals with trees, *i. e.*, forestry, and it is a good sign of a broadening view of the work of the university and its relation to the community that not only are courses in forestry now offered by a considerable number of colleges and universities, but in addition their professors are writing books on the subject. Trees are no longer regarded by the botanist as mere species having place in a scientific system of classification, and on a definite portion of the earth's surface. These facts are important; fully as important as they have ever been, but we have learned that these giant plants have other interesting relations. We have found it as interesting to study the biology of a pine or an oak as of a microscopic alga or fungus. How to grow a tree is as legitimate a subject of inquiry as how to grow a particular bacterium or saprophytic fungus. The ecology of the forest affords as many interesting problems as the study of the zones and belts of ponds and swamps.

A little more than five years ago Professor Green, of the University of Minnesota, prepared a little book under the modest title of 'Forestry in Minnesota,' of which an edition of 10,000 was published by the Minnesota Forestry Association. After about three years, this edition being exhausted, Professor Green prepared a second which was published as a bulletin of the Geological and Natural History Survey of Minnesota. He has now revised the book again, enlarging and making it more general, so as to adapt it to the whole of the United States. Its title is now more general also—'Principles of American Forestry'—and it bears the imprint of John Wiley, of New York.

The scope of the book may be learned from an enumeration of the principal chapter headings, as follows: 'The Tree and Tree Growth'; 'The Forest'; 'Forest Influences'; 'Forest Regeneration'; 'Propagation'; 'Forest Protection'; 'Rate of Increase in Timber Trees'; 'Uses of Wood'; 'Durability'; 'Forest Economics'; 'The Important American Timber Trees'; etc.

A single quotation from the chapter on forest regeneration will suffice to show at once the style of treatment and the considerable botanical interest that this study involves, as presented in this admirable book:

> Succession of tree growth is an expression sometimes used as though there were a natural rotation of trees on the land. There is nothing of the sort. Sometimes hardwoods will follow pine, or the pine the hardwoods, where the two were mixed at the time of cutting, and there was a young growth of one or the other kind which had a chance to grow when its competitor was removed. Where land is severely burned after being cut over, the trees that show first are gen-

erally the kind with seeds that float long distances in the wind, such as poplar and birch, or those having fruits especially liked by birds, such as the bird cherry, which is very widely distributed. These show first on account of getting started first. The pine and the other trees may come in later owing to their being seeded later, or owing to the later advent of conditions favorable to their germination and growth. It may happen in the case of burnt-over pine lands that pine seed is distributed over it the first year after it is burned, but owing to there being no protection from the sun, the young seedlings of white and Norway pine, which are very delicate, are destroyed. After a young growth of poplars has appeared, the pine seed may find just the right conditions for growth for a few years, and finally get ahead of the poplars and crowd them out, while in the meantime it is being much improved by the presence of the poplars which grow rapidly and force the pines to make a tall growth. On the other hand, however, the poplars, birches and other trees and shrubs, and even weeds, may sometimes make so strong a growth as to kill out the young pine seedlings if they are not sufficiently well established at the time the mature growth is cut.

### AN ENGLISH EDITION OF SCHIMPER'S PLANT GEOGRAPHY.

For several years it has been known that an English edition of Schimper's 'Plant Geography' was in preparation, the work having been undertaken by Professor William R. Fisher, with the advice and consent of the author. 'The untimely death of the author in 1901, shortly after the translation was begun, robbed the English edition of modifications and improvements which he had intended to make,' so the text of the book is exactly that of the German edition of 1898. The book in its English dress is characterized by the beautiful typography, paper and binding of the Clarendon Press of Oxford, and is a thick octavo of 869 pages (as against 894 in the German edition), and four maps. The only changes noticed are the omissions of the key-page to the plate of rock vegetation (Fig. 487), and the new plate for Map IV. at the end of the volume. The latter is much coarser in the Oxford map, and while it is much more distinct, it is considerably less accurate on the whole, than the German map. The translation has been revised and edited by Dr. Percy Groom and Professor Balfour, and Dr. Groom has added a sympathetic sketch of Schimper's life work.

Charles E. Bessey.

The University of Nebraska.

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### SCIENTIFIC NOTES AND NEWS.

At the annual meeting of the Royal Astronomical Society on February 12, Ambassador Choate received the society's gold medal on behalf of Professor George E. Hale, of the Yerkes Observatory.

McGill University has conferred the degree of D.Sc. on Professor D. P. Penhallow, professor of botany at the university, and on John A. Low Waddell, a consulting engineer of Kansas City.

Lord Rayleigh has been created, by the German Emperor, a foreign Knight of the Prussian Order Pour le Mérite for sciences and arts.

Mr. F. E. Beddard, F.R.S., of the London Zoological Gardens, has been elected a corresponding member of the Imperial Bohemian Academy of Sciences.

The following have accepted positions on the permanent staff of the Station for Experimental Evolution of the Carnegie Institution, at Cold Spring Harbor: Professor C. B. Davenport, who will serve as director; Mr. Frank E. Lutz, who will make quantitative studies in animal variation; Mr. George H. Shull, whose work will be largely in plant breeding and the study of mutations in nature; and Miss Anna M. Lutz, who will serve as recorder and cytologist. The plans of the new building are now in the hands of the architects, Messrs. Kirby, Petit and Green, of New York City, and construction will commence as soon as the frost is out of the ground, so that the building may be in use next summer.

Dr. Charles J. Chamberlain, of the Department of Botany of the University of Chicago, has received from the Botanical Society of America a grant to defray the expenses of a trip to Jalapa, Mexico, for the

purpose of studying cycads. Assistant Professor Bradley M. Davis, of the same department, has received an appointment to a Carnegie table at the Zoological Station, Naples, for the spring of 1904.

*Nature* states that the Tanganyika committee (Professor Ray Lankester, Sir John Kirk, Sir W. Thiselton-Dyer, Mr. Boulenger and Dr. Sclater) has determined to send out another naturalist for the further investigation of the 'Tanganyika problem,' and Mr. W. A. Cunnington, of Christ's College, Cambridge, has been appointed for this purpose. Mr. Cunnington will leave for Tanganyika (*viâ* Chinde and Zomba) in March, and will pay special attention to the lacustrine flora of the lake, of which as yet little is known, but will not neglect other subjects relating to the lake basin.

Dr. Eduard Zeller, emeritus professor of philosophy in the University of Berlin, celebrated his ninetieth birthday on January 22. Emperor William presented him with a portrait and an autograph letter.

Professor August Weismann's seventieth birthday was celebrated in Freiburg on January 17, when, as we learn from *Nature*, a large and representative gathering assembled to do him honor. A bust by Kowazik, of Frankfort, subscribed for by biologists in various parts of the world, was presented in the name of the subscribers by Dr. H. E. Ziegler, professor of zoology at Jena; it is to be placed in the zoological institute of the university. A special number of the *Zoologische Jahrbücher*, containing papers by various naturalists, was presented by Professor J. W. Spengel, professor of zoology at Giessen, and from the Grand Duke of Baden Professor Weismann received the cross and star of Bertold I.

Dr. Adolph Franck, of Berlin, known for his contributions to chemical agriculture, celebrated his seventieth birthday on January 20.

Dr. Joseph Jastrow, professor of psychology and logic at the University of Wisconsin, has sailed for Europe to be absent until the autumn.

It is said that Dr. Nicholas Senn, of Chicago, will have charge of the red cross work of the Japanese army.

A grant of $500 was given this year by the Rockefeller Institute of Medical Research to Dr. A. S. Warthin, professor of pathology in the University of Michigan, for his researches on the etiology of the anemias. The grant has been used for the establishment of a fellowship in pathology, to which Mr. H. Woltmann has been appointed.

Mr. W. Saville-Kent will shortly leave England to investigate and advise towards the further development of the pearl, shell and other fisheries pertaining to certain Polynesian Island properties.

It is reported that M. Curie has declined the cross of the Legion of Honor offered him by the French government, because it has not also been offered to Mme. Curie.

Professor W. F. Barrett has been elected president of the Society for Psychical Research, succeeding Sir Oliver Lodge.

Dr. Hermann M. Biggs, of New York City, gave, February 15, one of the lectures on tuberculosis before the Henry Phipps Institute of Philadelphia, his subject being 'The Administrative Control of Tuberculosis.'

At Trinity College, President David Starr Jordan will lecture on February 19, on 'Modern University Tendencies,' and on February 26, Professor Henry Fairfield Osborn, on 'The Evolution of the Horse.'

Mr. Frank Chapman, of the American Museum of Natural History, gave a lecture, on January 24, before the Audubon Society at Sherry's, New York City, his subject being 'Travels of a Bird Lover.'

Professor Elwood Mead, expert in charge of irrigation investigations for the United States Department of Agriculture, who also holds the chair of the institutions and practice of irrigation in the University of California, has left Washington, D. C., for California, where he will deliver his annual course of lectures on the 'Organization of the Irrigation Industry.'

Under the auspices of the West India Committee, London, Dr. John S. Flett read a

paper on February 9, on 'The Volcanic Eruptions in the West Indies'; on March 8, Sir Frederick Manson will read a paper on 'Tropical Diseases.'

The prizes in the gift of the *Journal of Tropical Medicine* for prize essays on subjects connected with tropical diseases have been awarded as follows: The Belilios prize of £10, presented by the Hon. E. R. Belilios, C.M.G., for the best article on 'The system of drainage and sewerage best suited for tropical climates,' has been awarded to Captain J. W. Cornwall and Major F. Smith. The Lady MacGregor prize of £10, presented by Lady MacGregor, for the best article on 'A critical examination of the practical value of anti-typhoid inoculation,' has been awarded to Major F. Smith. The Sivewright prize of £10, presented by Sir James Sivewright, for the best essay on 'Intestinal affections in warm climates,' was not awarded.

Joseph Priestley, the discoverer of oxygen, died at Northumberland, Pa., February 6, 1804. On February 7, 1904, the Unitarian Club of Washington held a meeting to commemorate the centenary of that event. The speakers were F. W. Clarke, on Priestley as a discoverer; Rev. U. G. B. Pierce, who discussed Priestley's religious career, and the Rev. Edward Everett Hale, who spoke of Priestley's connection with America.

Dr. David Duncan, having been entrusted by the late Mr. Herbert Spencer with the writing of his biography, will be obliged to persons who may possess letters from him of value if they will kindly lend them to him for the purpose of such biography. All letters addressed to Dr. D. Duncan, care of H. R. Tedder, Esq., secretary, the Athenæum, Pall-mall, London, S. W., will be carefully preserved and returned in due course to their owners.

Dr. Charles Emerson Beecher, professor of historical geology at Yale University and a member of the governing board of the Sheffield Scientific School, died suddenly from heart-disease on February 14.

Mr. W. B. Powell died at Mount Vernon, New York, on February 6, at the age of sixty-seven years. Mr. Powell was for many years superintendent of schools in Illinois and occupied this position at Washington, D. C., from 1885–1900, where he introduced many reforms. He was a brother of J. W. Powell, the late eminent anthropologist.

There will be on March 1 a civil service examination to fill the position of pharmacologist in the Bureau of Plant and Animal Industry, U. S. Department of Agriculture, at a salary of $800 a year. On March 2 and 3 there will be an examination for miscellaneous computer in the U. S. Naval Observatory, the salary of the position amounting to from $800 to $1,000 a year. On March 16 and 23 there will be examinations for the position of aid in the National Museum in the Division of Fishes and in the Division of Birds' Eggs, with salaries of $600 and $540 a year, respectively.

Mr. Samuel H. Scudder has given to the Boston Society of Natural History his private library of nearly eight thousand pamphlets and volumes. This addition makes the society's collection of entomological works one of the foremost in the country.

The New York Evening *Post* states that Professor J. Laurence Laughlin, of the University of Chicago, has been authorized by a Chicago business firm to offer four prizes for the best essays on topics relating to commerce and industry. The first prize will be $1,000, the second $500, the third $300, and the fourth $150, and any person who has received the degree of bachelor of arts from an American college since 1893 is eligible to compete. The essays are to be judged by Professor Laughlin; Professor Clark, of Columbia University; Professor Adams, of the University of Michigan; Dr. Carroll D. Wright, of Washington, and Horace White, of New York.

At the ordinary quarterly *comitia* of the London Royal College of Physicians, held on January 30, the President, Sir William Church, announced that Dr. Horace Dobell, of Dorset, had presented a sum of £500 in cumulative consols to the college for the promotion of original research into the ultimate origin, evolution and life history of bacilli

and other pathogenetic microorganisms. The conditions are that the president and censors of the college shall select a lecturer once in every two years, who shall give a record of original researches on the above subject, made by himself and others, and that he shall receive a fee of £50 for so doing. These lectures are to be continued biennially, as long as a sufficient amount of the £500 and its accumulated interest remains. The first lecture will be delivered during the year 1904.

AT the recent meeting of the Society for Psychical Research, it was announced that the sum of $30,000 had been collected for a scholarship, which it was hoped would be increased to $40,000. The English society now numbers 832 members, and the American Society 530 members.

THE Philadelphia Neurological Society celebrated its twentieth anniversary on January 27 by a dinner at University Club. Speeches were made by Dr. S. Weir Mitchell, Dr. E. C. Spitzka, Dr. George Lincoln Walton, Dr. Wharton Sinkler and Dr. Charles K. Mills.

THE annual meeting of the American Institute of Mining Engineers, which was to have been held in Baltimore from February 16 to 20, has been called in Atlantic City, N. J., owing to the Baltimore fire.

A CONGRESS for experimental psychology is to be held at Giessen, beginning on April 20.

THE tenth Congress of Polish Physicians and Scientific Men will be held at Lemberg, Austrian Poland, on July 20–24, 1904. Professor E. Machek is chairman, and Professor W. Sieradzki is secretary of the committee of arrangements.

THE British parliamentary committee on physical deterioration is now holding sittings. Evidence has been given by Dr. D. J. Cunningham, professor of anatomy at the University of Edinburgh and chairman of the anthropometric committee of the British Association, by Sir Lauder Brunton, M.D., F.R.S., Mrs. H. G. Close, Mr. J. B. Atkins, London editor of the *Manchester Guardian*, Dr. Edward Malins, president of the Obstetrical Society and others.

A PETITION is being extensively signed in Great Britain in support of the bill for the adoption of the metric weights and measures which will be introduced in the house of lords by Lord Belhaven, and seconded by Lord Kelvin.

AN industrial and agricultural exposition is to be held at Nantes during the present year, beginning on May 5 and ending on September 22. The exposition is to be international in character and is to comprise four sections—agriculture, industry, marine and fine arts.

THE Davenport Academy of Sciences gave during January and February a course of seven lectures as follows: 'Some Interesting Features of Insect Life,' by Dr. L. O. Howard, Division of Entomology, Washington, D. C.; 'Protective Coloration among Animals,' by Professor C. C. Nutting, University of Iowa; 'Alamogorda, A Problem of the Desert,' by Professor Thomas H. Macbride, University of Iowa; 'Sanitary Engineering,' by Professor Charles S. Magowan, University of Iowa; 'Man in the Tropics,' by Professor Bohumil Shimek, University of Iowa; 'The Geology and Scenery of the Pipestone Region,' by Professor Samuel Calvin, University of Iowa.

THE U. S. Geological Survey has published a paper on 'Chemical composition of igneous rocks, expressed by means of diagrams, with reference to rock classification on a quantitative chemico-mineralogical basis,' by Professor J. P. Iddings, of the University of Chicago. The materials erupted from the depths of the earth vary greatly in composition. Silica, alumina, iron, magnesia, lime, soda and potash are present in considerable amounts in most eruptive rocks, and other substances often occur in notable quantities. The mineralogical composition and, through that, various other features of igneous rocks, depend in large degree upon the chemical composition of the fluid magmas of which they represent the solid forms. It is, however, difficult, even for the specialist in this science, to perceive readily the significance of the differences in composition between two rocks when presented in the form of long chemical analyses; hence petrographers have for many years sought to express in the form

of some diagram the principal facts of each analysis, so that they may at once appeal to the eye. Professor Iddings describes the various kinds of diagrams that have been used, finally explaining the kind which seems to him the most useful. These diagrams express the relations of all the leading constituents of an analysis. Professor Iddings has also devised a plan for the comparison, upon charts, of diagrams representing separate analyses, so that the full range of composition found for known igneous rocks is at once illustrated. This publication presents these charts, which are printed in four colors and accompanied by descriptive text. This graphic representation brings out many facts concerning the composition of the earth's magmas. The fact that there are no well-defined chemical groups of rocks, but rather a continuous series with no natural dividing lines, is clearly illustrated. The author discusses the relations exhibited by the charts, with particular reference to rock classification.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

Columbia University, the Massachusetts Institute of Technology, the Lawrence Scientific School of Harvard University and the Sheffield Scientific School of Yale University will unite in a summer school of mining to be held in Colorado. The conduct of the summer school is to be in the hands of an executive committee, consisting of Dr. John Hays Hammond, representing Yale University; Professor Robert H. Richards, of the Massachusetts Institute of Technology; Professor Henry L. Smyth, of Harvard University, and Professor Henry S. Munroe, of Columbia University. The last named has been appointed director of the school for the first year, and he will have under him a corps of competent instructors drawn from the several institutions. Mr. George Crocker, through Professor John Hays Hammond, has offered to pay the cost of the school this summer, and has placed $12,000 for this purpose in the hands of Mr. Hammond and the presidents of the four institutions named, who will act as trustees of the fund.

The new science and administration building of Colorado College, at Colorado Springs, known as Palmer Hall, will be formally opened with various celebrations during the latter part of the month. The dedicatory address will be delivered on February 23, by Dr. David Starr Jordan; on February 22 addresses will be delivered by Dr. C. R. Van Hise, Dr. S. L. Bigelow, Dr. C. E. Bessey and Dr. Henry Crew. The new building has been erected at an expense of $280,000, and contains ample laboratory facilities for the scientific department, a museum, etc.

A number of influential heads of colleges and professors at Oxford have issued a leaflet urging that candidates for honors in mathematics and natural science shall be allowed to substitute for the entrance examination in Greek, mathematics, a science or a modern language.

Henry S. Williams, since 1892 professor of geology in Yale University, where he was called from Cornell University, has accepted a call to the head of the department of geology at Cornell.

Dr. W. R. Whitehorne, formerly professor of physics and chemistry at Muhlenberg College, Allentown, Pa., has been appointed instructor in physics at Lehigh University.

Dr. Waldemar Koch, associate in pharmacology in the University of Chicago, has resigned to accept the assistant professorship of pharmacology and physiological chemistry in the University of Missouri.

Dr. George Byron Gordon has been appointed instructor in anthropology in the University of Pennsylvania.

Dr. W. S. Bayley has resigned the chair of mineralogy and geology at Colby College which he has held since 1888.

Professor Charles H. Haskins, of the mathematical department of the Sheffield Scientific School, Yale University, has resigned because of impaired health.

Dr. Bonnhöfer, of Königsberg, has been elected professor of psychiatry and director of the Insane Asylum at Heidelberg.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 26, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

### *THE RELATION OF MATHEMATICS TO ENGINEERING.**

A FEW years ago technical education as we now understand it was unknown in America. We have now in our midst more than 20,000 students preparing themselves distinctively for the engineering profession.

While the technical schools of the country have had a development which for rapidity, strength and importance is little short of marvelous, yet their rise and growth have been profoundly influencing the thought as well as the welfare of the nation. Especially in the domain of mathematics have they had a directing and vivifying influence which is little short of a revolution. To-day mathematics wishes no stronger reason for her existence and no stronger call to her cultivation than the fact that she is the unchallenged doorkeeper to the appreciation and mastery of the physical sciences, both in their theory and in their application by the engineer to things useful.

The time is past when mathematics is referred to by the thinkers of the day as being principally a discipline. It is of course true that, rightly pursued, mathematics is a discipline, but it is far more, it is a knowledge, a tool, a power, a civilizer. The day is gone when, on the one hand, the student, Chinese fashion, learns his geometry word for word from cover to cover or memorizes all the propositions of his

* Vice-presidential address before Section D, American Association for the Advancement of Science. St. Louis meeting, December, 1903.

analytic geometry down to the last index and subscript, or, on the other hand, when the devotee of a cult toasts his favorite subject with the words 'Here's to the higher mathematics, may they never be useful.'

To the workaday world the higher ranges of mathematics have been a sealed book; the man who traverses them successfully a magician—a man whose mental occupations awaken mingled feelings of awe and pity, awe that he can soar so high, pity that he wastes his strength in such useless flight. A generation ago the mathematician was joined in hand with the Roman and the Greek, and the three easily persuaded the educational world that they were the divine trio. Without them for a basis there could be nothing but a sham college course. Why it was that these three lines of study held such a commanding and, for the most part, unchallenged position, it is now difficult for us to say. Possibly they gained higher esteem as means of mental discipline because their most ardent votaries so seldom succeeded in making them directly useful except in certain narrow professional lines. Of the men in college courses who studied required mathematics beyond trigonometry very few gained any vital conception of analytic geometry and the calculus. To most collegians the mass of symbols with which they juggled in pursuing these subjects was a distressing nightmare, a matter of jest and to be forgotten with all possible speed.

Our colleges to-day have seen a great light and have reformed their curricula. They now know there is no discipline in the pursuit of mathematics to the man who does not understand its language. Early in his course, if not throughout it, the student is allowed the more rational way of getting his education, by pursuing subjects that he *can* understand. This sensible treatment of educational material has grown up during the development of technical colleges and may be referred in a measure at least to their influence. Certainly great advance in the teaching of mathematics has recently been made, yet very much remains to be done, and the next great forward movement seems to be coming directly from the engineers and the forces they are setting in operation.

The literature on the question of reform in the teaching of mathematics is growing rapidly. In 1901 John Perry, professor of mechanics and mathematics of the Royal College of Science, London, and chairman of the Board of Examiners of the Board of Education in Engineering and Mathematics, produced a profound impression upon the British Association by a paper on 'The Teaching of Mathematics.' His ideas require attention further along. In Germany Nernst and Schoenflies, for example, have met the thought of the hour in their 'Einführing in die Mathematische Behandlung der Naturwissenchaften.' In our own country Perry centers are springing up for the reformation and profound improvement, if not revolution, of mathematical teaching in our secondary schools. In the west the apostle of this movement is Professor E. H. Moore, of Chicago University. One needs only to read his admirable presidential address before the American Mathematical Society in New York almost exactly a year ago to understand the full meaning and extent of the changes sought.

The address will be found in the number of the *Bulletin of the American Mathematical Society* for last May, and it will repay a careful perusal on the part of those of you who have not read it. Professor Moore has been counted as a pure mathematician of the most pronounced type, but into this new movement he has thrown himself with the ardor of one whose whole life had been spent in applying a wide range of mathematical power to the design and construction of the great objects of engineer-

ing. If the reformation which has been planned and begun shall go on to completion, the mathematical teaching in the secondary schools of the middle west will have little resemblance ten years hence to the work of to-day.

Arithmetic, algebra, geometry and trigonometry will no longer be set off in 'water-tight compartments,' but will all be demanded in various combinations for the solution of single elementary problems. Squared and polar coordinate paper will represent the facts to the eye in geometrical symbolism and at the same time will give a practical introduction to the fundamental ideas of analytics and the calculus. By pursuing through the four years of secondary school life a carefully selected and properly graded problem course the pupil will review the whole range of elementary mathematical truth and become familiar with it, not only in theory, but also in practice. He will never be asking, 'what use?' But with the enthusiasm which original investigation only can arouse he will find his educational material in the simpler problems of the shop, the store, the farm, the bank, the railroad, the steam-boat, the steam-engine, the electric motor, political economy, geodesy, astronomy, time, space, force and so on through the range of the elementary aspects of the things of daily thought and experience in this complex and highly developed life of ours. Such a change can not be perfected in a day. No inferior or untrained teacher can succeed with it. Elementary work must be in the hands of those who have come into living contact with some of the deep, broad problems of chemistry, of physics and of engineering, demanding for their solution a large acquaintance with the higher ranges of mathematics. In turn colleges and universities which strive to train such teachers must revise their mathematical courses and adjust themselves to these new ideas.

In many of our leading institutions exactly that thing is occurring, stimulated perhaps in the first place by the great demand of technical colleges for mathematicians in sympathy with engineering ideas.

Those who are dealing with freshmen in colleges are asking the question, 'What is the matter with our preparatory schools?' If you wish to see this question strongly formulated and illustrated, read the commencement address of 1903 by President Ira Remsen at Mount Holyoke College.

This is the indictment of the schools, that they use, largely to the exclusion of the thought element, a mass of formal and conventional educational material and thus paralyze thought and make abortive any natural mental growth.

In the grades the clear, keen, accurate thinking of childhood soon disappears and does not usually show itself again until the laboratory or the practical problems of life make it once more dominant. We refer to President Remsen's question only so far as it relates to mathematical training. The technical schools long ago recognized the barren results of primary and secondary mathematical instruction and have been deeply interested in its improvement. Most keenly this loss has come to the engineer who must subject himself to the long, hard discipline necessary in his profession for the successful solution of his original and independent problems. Yet certain people seem to look askance upon the engineer and discover no advancement of science in the design of an entirely new machine to carry out an entirely novel idea. According to their notion, Whitney was not a scientist when he invented the cotton gin, nor Fulton when he constructed the first steam-boat, nor Morse when he perfected the telegraph.

This was all pure commercialism. Even if these worthies cared nothing for the financial side of their work and only sought to serve and benefit their fellow men, they

could not be classified with the man who describes an unrecorded bug, or the one who makes a new but useless chemical compound. The latter work without the hope of direct money return for their labors. Therefore, theirs is the true method and the higher life even when their disinterested consecration to science is mingled with a hope that a little fame will bring them an increase in salary from some practical person or persons who appreciate their unselfish efforts.

However all of this may be, we know that the essence of any engineering work worthy the name is its independence. With this there is usually some degree of originality, as it seldom happens that the same problem repeats itself in every particular. What is more, with the independence and originality of the engineer must come character—confidence in his own mental processes and a willingness to shoulder responsibility in embodying his conclusions. A scientist may announce his discovery of the tidal evolution of the moon and yet be forgiven if later it should be shown that he is in error. Not so with the engineer. When his bridge falls under prescribed conditions of safe load, his own ruin as well as that of his structure is complete. Of all men living the intellectual life the engineer is the one most interested in sound and logical training for his profession and most intolerant of all shams. It is not surprising then that the one subject in secondary schools whose natural purpose is to train the student to severe logical and productive thinking should respond most fully to his influence. Neither is it surprising that from the ranks of the engineers should come the reformer who sees clearly the defects of our present mathematical work in the lower grades and who is moving powerfully to secure better conditions.

We may sum up what now seem to be the best ideals in secondary mathematics as follows:

These ideals come from the engineering professions.

They insist upon quality rather than quantity.

They insist that the problems shall be largely concrete and shall be worked out to an accurate numerical result.

They insist that the thought shall precede the form, that the symbol shall not conceal the thing symbolized.

They insist that systematic and progressive problems based upon every-day experience and observation shall be, to a much greater extent, the materials of education.

They demand that the several elementary mathematical subjects from arithmetic to the calculus shall develop side by side in the boy's mind.

They demand that the mastery of these subjects shall be more the work of the judgment than of the memory.

They demand that from first to last, at least during the secondary period, mathematical ability and the ability to think clearly, investigate closely and conclude correctly shall develop together, and to the extent that four well-spent years will on the average permit.

Those who formulate these ideas contend that they lead to the correct mathematical training for all professions and all careers.

It remains for us to consider the mathematical courses in our technical colleges. What is their relation to the development of the engineer? What shall they include? How shall they be administered? These are not new questions, neither has the last word been said in answer to them. Fifteen years spent in directing engineering mathematics gives the writer some excuse to undertake some further discussion of them.

Important contributions were made by Professor Mansfield Merriman in 1894, and Professor Henry T. Eddy in 1897, whose

articles are published in the *Proceedings of the Society for the Promotion of Engineering Education,* Volumes II. and V. But among the most suggestive discussions during the last year, as well as all previous years, are the papers of some of our brightest electrical engineers presented at the joint meeting last July at Niagara Falls of the society just mentioned and of the American Institute of Electrical Engineers and published this year in the proceedings of both societies. To those interested in finding the best educational conditions leading to the average as well as the most important engineering operations of the day these papers come with peculiar weight and authority. Judging from the expressions of opinion contained in them the active engineer in his occupation, at least, cares nothing for the philosophic basis of the concept of number, nor for the geometry of non-euclidian space, nor for Grassman's *stufe* of the fifth or sixth degree, nor for computations of plane triangles when the sum of the angles is less than 180 degrees. These subjects may and should interest the professional mathematician, but the engineer asks first for the ability to use numbers rapidly and to carry numerical computations, no matter how complex, to an accurate conclusion. As for ordinary mathematics, including of course elementary geometry, algebra and trigonometry, the engineer should know them as he 'knows the currency of his native country. In other words, he ought to be able to make change with ease, quickness and accuracy—not as if one were in a foreign country in a constant state of painful reckoning.'

On a basis of barter modern business would be strangled. The very existence of commerce in the modern sense, in which the line of cost and profit is so finely drawn, would be utterly impossible without a standard currency. So without mathematics engineering would be a mass of empiricism and tradition. Instead of a pioneer leading the way in the progress of the people it would be an outcast trailing in the rear of every science.

This proposition that mathematics is the very bone and sinew of an engineering course needs no discussion. It is everywhere conceded. The extent and nature of the mathematical element in the curriculum, however, are two decided fluents with curves of opposite slope. More mathematics but fewer kinds seems to be the tendency. The opinion appears to be gaining ground that the purely descriptive and highly specialized and professionalized elements in our technical courses should be reduced, while more subjects with a mathematical basis, with long unbroken continuity and bound together with a strong logical element should command the attention of the student to the end of his undergraduate period.

Upon the question what mathematical subjects shall the undergraduate courses include in our technical colleges, opinions are decidedly at variance. Upon the four ordinary elementary subjects the sentiment is practically unanimous, but these should be principally taught in the secondary schools. The practical people, however, are inclined to relegate analytic geometry and the calculus to the scrap pile.

To such subjects as vectors, theory of functions, theory of groups, they allow no place whatever.

One can not but feel that this verdict against analytic geometry and the elementary calculus—not to mention higher subjects—is a great pity. Especially does it seem true when we recall that instruction in these two lines forms the principal mathematical element of the second and third years of the ordinary technical course and that the calculus itself is probably the most powerful and wonderful tool for in-

vestigation that the genius of man has ever contrived.

The student of mathematics who has reflected deeply upon the meaning and interpretation of its symbolic language knows that man, in his struggle for the mastery and direction of nature's laws and processes, has no more subtle and no more powerful ally than he finds in the calculus. The other subjects leading to it are conventional and highly artificial, but with this one we return to simplicity and operate with perfect ease and freedom in the realms of time, space and force.

As we find nature operating by growth, and force by insensible gradations, so over against that the calculus is the science of continuous number. Why then does the mathematician find so much in this, his favorite subject, while the practical engineer—even the one of great ability, proficiency and success—is inclined to think that time spent upon it is wasted or at least not employed to the best advantage? Why this great divergency in conviction?

No one will doubt the ability of our best mathematical instructors and teachers, nor their perfect familiarity with the matter they are teaching. But are analytics and the calculus—especially the latter—presented to the average student in the best way? Does not the formal smother the thought element and leave nothing but routine machine work upon symbols? As the student learns laboriously how to find the first derivative of a wide range of *rider* problems has he a faint conception even of what it is all about? Sir William Thomson, you know, said he did not understand an equation until he could make a model of it. Is the average student able to make a model of his operations with the differential calculus? And when he takes up the integral calculus and begins his attack upon a mass of algebraic and transcendental functions, using at times devices of great complexity and extreme refinement, does he usually walk by sight or by faith? Does he not often go forward long and painful journeys in utter darkness as to the meaning of it all, trusting, hoping, praying that by and by his teacher and his text-book will land him on solid ground and in the clear light to revel and operate in a new world of thought and action? How many men of good natural endowments, who are sorely needed in the higher ranks of the world's workers, become terrified in this period of distressing gloom; how many have lost individual initiative and independence and are content thenceforward to walk, not upright, vigorous, aggressive, daring, in the clear light of right reason, but by faith, humble and submissive?

Why do practical men almost unanimously place calculus among the dispensable elements of a technical curriculum?

The answer, of course, is very simple; they have never found any use for it, probably because they have never learned how to use it. Yet they dare not pronounce against it altogether. They know that Rankine and Maxwell were master mathematicians, and that through this mastery of the most powerful of tools they were able to do for terrestrial what Newton and Laplace did for celestial mechanics. In college the engineer has not learned to use the modern tool called the higher analysis; it remains to him as foreign currency. Out of college he has not time to learn its use. Are you a teacher of mathematics and did you pursue the subject under the direction of a master; yet how many classes did you yourself guide through the calculus before its hidden meaning, its range, its versatility, its power, were in any adequate measure revealed to you? How simple and how majestic it has now become! But if you were so slow in reaching the true light, is it to be wondered at that students

who go over the subject but once and under conditions not greatly superior to those of your own college days should not see clearly and should not use what they so little understand! Because, as matters now stand, the man who does not repeat his course in calculus many times will fail to appreciate it and use it, shall we say that it should be cut out of the engineering courses and its place taken by more algebra, more trigonometry and more descriptive geometry, or shall we retain it and reform its presentation? The true mathematical teacher will always vote for the latter proposition whatever may be the attitude of the professional man on the faculty or the pressure from the outside of the practicing engineer. How, then, may the higher analysis in our technical schools be made effective as a true means of discipline and as a tool with which to equip the engineer in his life of investigation?

It is to be understood that the answer to this question here is not claimed to be *the word* nor the *last word* on so important a topic. It is *a word* to be taken for what it is worth.

1. The most effective teaching of the higher analysis will be possible only when the reforms in mathematical instruction referred to earlier in this paper have permeated the principal secondary schools.

2. The teacher should be saturated with his subject. Not only should he be strong and apt on the formal side, but more important still, its inner meaning should be clear to him and its close relation to the phenomena of the objective and subjective life. Some contend that the only man to whom the mathematics of a technical college can be entrusted is an engineer. Does that make any difference? Rather are not these the essential questions? Does the man know his subject? In his teaching can he assemble from engineering and other records the material that will vitalize his work? Is he in sympathy with engineering essentials and ideals?

3. Throughout the college course the teaching should be mainly concrete. The problem, say from the physical sciences including engineering, should first be presented concretely. It should then be stated in mathematical symbols. The operations performed upon the symbols should be accompanied by drawings or models, the final result reduced to numerical form and then interpreted in language. Upon every problem the student must bring to bear the whole range of his acquired powers and be taught to select the shortest method within his ability.

In other words, all typical problems should receive a threefold consideration: (*a*) Its statement in words, and the statement in words of its solution when effected; (*b*) its graphical statement and solution involving geometry and mechanical drawing with squared paper; (*c*) its analytic statement and solution, ending with a numerical result.

4. The purely formal should be presented as a necessity arising from the so-called practical and in order that a body of knowledge and technical ability may be accumulated which will give the student easy control over the practical in whatever one of its various forms experience shows that it may arise.

5. The problems chosen should be progressive in character and their mastery should amount to a complete laboratory course in all that part of the higher analysis in which it is desirable that the engineering student should be well versed.

6. The course should be lecture and seminarium and individual, more after the manner of the German Technische Hochschule. The text-book should become a book of reference. The instructor should know clearly and be able to state accurately the limitations of his methods; but abstruse

discussions of obscure points should be postponed as long as a due regard for logical development will allow. Time is wasted in removing difficulties whose existence and importance the student has not yet recognized.

These are some of the necessary extensions into college work of the reformation now urged upon the secondary schools, and though every one of them seems familiar enough when taken separately; all together their united application to the mathematical courses in our technical colleges amounts to a departure from our present traditional methods little short of revolutionary. Yet isn't this the thing our engineers are demanding, and isn't this the logical way to train an engineer in higher mathematics? Isn't it the way to approach the higher mathematics anywhere or in any kind of a school?

The pure mathematician may object and exclaim, What is to become of our curricula which have been evolved after so many years of intellectual conflict! The rule is so much algebra, so much geometry, so much trigonometry, so much analytical geometry and so much calculus. At the end the student has passed with greater or less success so many formal examinations upon so many formal topics and his acquirements are supposed to range somewhere between the maximum and minimum grade of passing. But are these the questions which the enlightened educator of to-day is asking? Is it not *How much power?* A dry, barren, fruitless familiarity with a number of highly specialized and unrelated things can not be education. The engineer demands that the unity of the mathematical branches should be emphasized and that they should accumulate in the soul of the student not as dry and unrelated facts, but as a magazine of energy.*

You may ask for some definite concrete expression upon the way that the study of calculus should be undertaken. This paper will close with an attempt at a brief answer to this question.

We will suppose that experimentally or otherwise the student is familiar with the equation of falling bodies $s=\frac{1}{2}gt^2$. By this time also the student must be somewhat skilled in the use of squared paper and acquainted with this curve itself through its application to parabolic mirrors or otherwise. Perhaps, our parabola had been studied from its geometrical side as a conic section. It now takes on a symbolic meaning, for it gives in a certain sense a picture of the first law of falling bodies. But does the student grasp the full meaning of the picture? Using the approximation $g=32$, we have a numerical equation. The abscissas of the curve represent elapsed time; the corresponding ordinates represent total space traversed. At some point on the curve proceed geometrically and analytically to construct the tangent, at every step making a threefold interpretation, one of the curve, one of the analysis, and one of the fact connected with these in the familiar phenomena of a falling body. Show the limiting position of the secant, deduce the number towards which your successive numerical approximations tend, and connect both of these with the velocity of the body at the point considered. Draw the tangent and show

* Little has been said in this paper about descriptive geometry and mechanical drawing as necessary parts of a general mathematical training. Both of these subjects are of the highest value as disciplinary studies. They make definite and effective other mathematical material. Is not one reason for the barrenness of mathematics in university courses the fact that these branches simple though they are, have been so long neglected? Do we not find one important explanation of the effectiveness of technical college mathematics in the fact that these subjects are always a large part of a technical training?

how it represents uniform velocity. Show that the results reached at one point on the curve are general and apply equally well to every point and that everywhere on your curve the geometrical tangent and your analytic limit interpret each other and give the rate or velocity of the falling body.

Note that the tangents are changing, that the corresponding numbers are changing and that these constitute a rate of change of velocities. Show graphically the oblique straight line representing the changing velocities. Give its graphical, its numerical and its nature interpretation. In the same way study the line parallel to the axis of abscissas representing gravity. Study the graphs and their relation to each other. Study the series of numbers resulting from the selection of equal increments along the $X$-axis, the relation, therefore, of these operations to the theory of number series. Connect the first differential coefficient with the tangents and with rates, the second with the changes of tangents or of rates of tangents, and thus with the thing in this problem that produces the changes of velocities, that is, with the force of gravity. Note the deformation of the original curve if the resistance of the air had been considered and its influence accounted for by some simple law. Construct the curve of the body projected upwards. Let up and down destroy each other, so that the ordinates at each point will be the algebraic sum of opposite motions. Note the point in the curve when the projected body is for an instant stationary in the air. Observe its connection with the first differential coefficient. Note the deformation of the curve due to the resistance of the air acting according to some assumed law.

Similarly, construct approximately the smooth integral curve which represents the movement of a steam railroad train from station to station fifty miles apart. Connect the contour of the curve with velocities and with forces, including in the latter the steam in the cylinder, gravity assisting or retarding, friction and air resistance always retarding. Note how the second differential coefficient carries us back to steam in the cylinders, the third to the causes leading to a variation of the artificial forces, such as fuel, skill in stoking, etc. Pursue maxima and minima problems in the same way. But now, instead of a rate of change directly dependent upon a conventional unit of time, we have relative rates of change and we quickly enlarge our ideas of the meaning and application of the first and second differential coefficient. We can safely begin the formal element of the subject. Even then we should continue the diagram and its interpretation, though we may be utterly unable to set the highly artificial equation over against any definite problem known to exist in nature.

Just as differentiation always has a symbolic interpretation in tangents and rates, so the integration of any expression may be interpreted as the finding of an area.

From engineering we have a remarkable series of connected quantities and these may be selected, as given by Professor W. K. Hatt in the *Railroad Gazette* of December 23, 1898, for illustrating the cumulative effect of successive integrations. Five successive diagrams used in engineering practice are connected by integrations. These are in their order the load diagram, the shear diagram, the moment diagram, the slope diagram and the deflection diagram.

But it is not necessary to enter further upon specific illustration. The higher analysis is replete with problems which the skilled teacher may use as stepping stones by which he may help the student to pass with safety to higher and higher mathematical attainment. Step by step he masters his method while he is gaining a

clearer insight into the causal relations of things about him.

The thought element is ever dominant. He goes from strength to strength until no task seems too difficult for his disciplined powers.

Two young men stand before an intricate machine. They are told that their success in life depends in large measure on their ability to understand and use it. One examines piece by piece the parts of which it is composed. He discovers the way in which these parts are connected, the material of which they are made, their size, their strength, their beauty. After long and arduous study, he knows very much about the machine but he can not put it in motion, he can not make it work, he can do nothing with it except to admire its perfection of form.

The other student begins to construct another machine like the one shown him. As it grows under his hands, he is constantly using it for every operation to which it can be applied. As it approaches completion he admires more and more its adaptability and wide range of useful applications. Its beauty no longer affects him greatly, but he is lost in wonder and admiration before its marvelous power. This power he harnesses to the car of progress and he himself becomes one of the benefactors of his race.

Do we need to stop long to discover who is the 'man thinking'?

In later years mathematical instruction in this country has greatly improved in its thought content, but it has responded slowly and conservatively to modern methods. We are still more English than German. In the work of training a master of the physical sciences the text-book and the senseless repetition of words and formulas falling upon the dull ear of an instructor half asleep have been replaced by the lecture, the laboratory and the seminarium. Why should not mathematics, so intimately related to them, follow their lead and partake in the benefits of modern methods carried to their legitimate and logical completion?

C. A. Waldo.

Purdue University.

## THE AMERICAN PHYSICAL SOCIETY.

The winter meeting of the American Physical Society was held in cooperation with Section B of the American Association for the Advancement of Science at St. Louis, joint sessions being held on December 29–31, 1903. The business meeting of the Physical Society was held on December 30, and the program for that day consisted of Physical Society papers.

The meeting was a distinctly successful one. The program, consisting of twelve papers, was as large as could be satisfactorily handled, and contained several papers of exceptional interest. While comparatively few eastern members were present, the attendance was, nevertheless, well up to the average of previous 'annual' meetings. The large attendance of physicists from the middle west, most of whom are only rarely able to attend the meetings in New York, offered a strong argument in favor of more frequent meetings in that part of the country.

At the annual election the officers of the past year were reelected, *i. e.,*

*President*—A. G. Webster.
*Vice-President*—Elihu Thomson.
*Secretary*—Ernest Merritt.
*Treasurer*—William Hallock.
*Members of the Council*—Messrs. E. Rutherford and W. S. Franklin.

It was decided to hold the spring meeting of the society (1904) in Washington, this action being taken in consequence of a cordial invitation extended to the society by the Philosophical Society of that city. Not only is the local membership of the society in Washington large, but the ad-

vantages of the capital as a place of meeting are exceptional, as was evidenced by the very enjoyable meeting there last winter. It seems, therefore, that a successful meeting may be confidently expected.

The Physical Society also voted to accept an invitation from the International Electrical Congress to hold a meeting in St. Louis during September, 1904, in connection with the meetings of the congress.

It was the sense of the council that a definite plan should be presented by the council at this meeting looking to the establishment of a western section of the society.

The papers presented were as follows:

*The Radioactivity of Ordinary Metals:* E. F. BURTON.

The conducting power acquired by gases when confined in a closed metal vessel has been explained as the result of two causes: (1) The radioactivity of the metal walls; (2) a penetrating radiation from without, which reaches the confined gas by first passing through the walls of the vessel. Mr. Burton has attempted to eliminate the latter rays by surrounding the vessel with a screen of water. A decrease in the conducting power of the confined gas was in fact produced, the decrease being approximately proportional to the thickness of water, and amounting to 32 per cent. when the water was 60 cm. thick. While the vessel was surrounded by a water screen of this thickness its conducting power was tested for different pressures, ranging from 19 mm. to 752 mm. The conductivity was found to be almost exactly proportional to the pressure. The author concludes that the conductivity is due to a penetrating type of radiation.

*Does the Radioactivity of Radium depend on the Concentration?* E. RUTHERFORD.

The intensity of the $\gamma$-rays from radium bromide was determined by the electrical method, first when the salt was in the solid form, and second when dissolved in a solution of radium chloride. The volume occupied in the second test was more than a thousand times as great as that in the first. No difference in the intensity of the $\gamma$-rays could be detected. Since the intensity of these rays serves as a comparative measure of the activity, the conclusion is reached that the activity of radium is independent of the concentration in the range covered by these experiments.

*The Heating Effect of the Radium Emanations:* E. RUTHERFORD and H. T. BARNES.

The authors described the results of further experiments on this subject. (For the preliminary experiments see *Nature,* October 29, 1903.) The evolution of heat by the emanation and by the deemanated radium was followed from the time of separation throughout the radioactive life of the emanation. The variation of the heating effects with time was found to be the same as the variation in radioactivity, *as measured by the a-rays.* Estimating the volume of the emanation released by heating one gram of radium as between $6 \times 10^{-4}$ c.c. and $6 \times 10^{-5}$ c.c., and assuming its density to be about 100 times that of hydrogen, the authors compute that 1 gram of the emanation would radiate during its life an amount of energy lying between $2 \times 10^{9}$ and $2 \times 10^{16}$ gram calories. A pound of the emanation would radiate energy initially at the rate of about 100,000 horse power.

*The Phosphorescence of Organic Substances at Low Temperatures:* E. L. NICHOLS and E. MERRITT.

About 120 substances, chiefly organic compounds of definite composition, were tested for phosphorescence and fluorescence at the temperature of liquid air. Of these only 21 failed to show luminescence at this temperature, while in numerous instances

the phenomena were quite brilliant. Except the phosphorescent sulphides no substances were found whose phosphorescence was *diminished* by cold. Perhaps the most interesting substance tested was tetrachlorphthalic acid. This showed both phosphorescence and fluorescence at —186° C., while quite inactive at ordinary temperatures. It was also stimulated by Roentgen rays, fluorescing under their influence as brilliantly as a good X-ray screen.

*The Spectro-photometric Study of Fluorescence:* E. L. Nichols and E. Merritt.

The authors investigated the spectrum of the fluorescent light from fluorescein and other substances when excited by light of widely different wave-lengths. The spectrum was found to be the same in all cases, even when the wave-length of the exciting light was greater than that of the brightest region in the fluorescent spectrum. In agreement with Lommel, and in opposition to Lamansky, Becquerel and others, two conclusions are reached, viz., (1) the distribution in the fluorescent spectrum is independent of the exciting light; (2) for substances of this class Stokes's law does not apply.

*The Electrical Conductivity of Liquid Films:* L. J. Briggs and J. W. McLane.

The thickness of films of Plateau's solution was computed from the area and weight, and the resistance of the films was directly measured. It was found by this method that the specific conductivity of films about 1 $\mu$ thick is less than one third that of the solution in mass.

*On the Use of Nickel in the Marconi Magnetic Detector:* A. L. Foley.

A detector with a core of nickel wires was found to have about the same sensitiveness as one using iron. The greatest sensitiveness was obtained by using a core containing both nickel and iron wires.

*On Double Refraction in Matter moving through the Ether:* D. B. Brace.

*Electric Double Refraction in Gases:* D. B. Brace.

The author presented a brief preliminary account of work on the subjects mentioned in the two titles above, but looked upon the experiments as not yet carried far enough to make a detailed report desirable.

*The Work of the National Bureau of Standards:* E. B. Rosa.

*The Spectrum of the Afterglow of the Spark Discharge in Nitrogen at Low Pressures:* Percival Lewis.

The phosphorescence studied is produced only in the purest obtainable nitrogen. Instead of a continuous spectrum, which is observed in most cases of afterglow, the light in this case gave a banded or line spectrum. The spectrum contains a number of unidentified lines, of which four in the visible region are especially prominent. Certain of the lines of nitrogen, mercury and aluminium (the last due to the electrodes) were also present.

J. J. Thomson has advanced the hypothesis that afterglow effects are due either to chemical actions in a mixture or to polymeric changes in a pure gas. If this be the explanation—and it seems a reasonable one—how can a chemically neutral gas excite luminosity in every metallic vapor which may be present, such as mercury and aluminium?

*The Spectrum of the Electrodeless Discharge in Nitrogen:* Percival Lewis.

The discharge was obtained in the form of a ring by the use of an oscillatory discharge in a coil surrounding the tube. Any effects due to electrostatic influences were eliminated by screens of moistened pasteboard. The spectrum showed the bands of the second and third groups, as classified

by Deslandres in the case of the positive column of the ordinary discharge with electrodes. The first group was entirely absent. It was interesting to find that some of the characteristic bands of the negative glow were also observed.

ERNEST MERRITT,
*Secretary.*

## SCIENTIFIC BOOKS.

*A Monograph of the Culicidæ or Mosquitoes.* By FRED. V. THEOBALD, M.A. Volume III. London, printed by order of the trustees of the British Museum. 1903. Pp. xvii + 359; 193 text figures; 17 plates.

Interest in matters connected with mosquitoes has been increasing so rapidly of late, and so many students and physicians in all parts of the world have been taking up the investigation of this family of dipterous insects, that Mr. Theobald's monograph of 1901, published in two volumes of text and one volume of plates, was hardly in the hands of investigators before almost enough material had accumulated for another volume. Between April, 1901, and February, 1903, over one hundred collections were received at the British Museum, and the present volume includes consideration of this material. In the volume are described 23 new genera, 88 new species and 8 new varieties. At this point Volume III. stops. Since that time already 25 new collections have been received at the British Museum, and whatever new forms are contained in these and subsequent collections will be described in journals, and it is not proposed to issue another volume until the arrival of new species slackens and the subject has reached a more final stage. This means that for some time to come people wishing to identify mosquitoes must base their work primarily upon the three volumes published and afterwards consult all sorts of scientific periodicals, both biological and medical, for descriptions of new forms, which will necessitate some rather extensive card-cataloguing. In the meantime it may parenthetically be stated that no doubt Mr. Theobald will be glad to name specimens for persons sending them to him, and the writer holds the services of his force at Washington at the disposal of inquiring medical men and other culicidologists.

In Volume III. the British Museum authorities have abandoned the colored plates which formed so attractive and excellent a feature of Volumes I. and II., but the text contains many figures giving anatomical details of the new species, including a number of figures of various stages. The plates are all done by the collotype process from photographs, and are in the main very good. Careful drawings would have been much better than some of them, especially the heads on Plate IX. and the larva and pupa on Plate XVI.

In the preparation of this volume Mr. Theobald has shown great care and very good judgment. He has been most industrious in bringing together many points concerning the biology of different species in spite of the fact that his main interest seems to have been in the classification of the adults, and as a matter of course the volume is a mine of information concerning the geographic distribution of species. He had before him practically no additional material from North America in the preparation of Volume III., although he introduces some Central American forms, some from the West Indies and a number from South America. The bulk of his additional material, however, has come to him from Africa, India and Australasian regions.

One point which he brings out which will be of interest to North American students is his decision that *Anopheles walkeri,* which he described from specimens (number not given) collected at Lake Simcoe, Ontario, in September by E. M. Walker, is really a synonym of *Anopheles bifurcatus* Linnæus of Europe, a species of rather wide European distribution, occurring from Lapland to Italy and the Mediterranean islands.

Since the publication of Volumes I. and II. an important attempt has been made by M. Neveu-Lemaire to formulate a classification of mosquitoes mainly on palpal and venational characters. Mr. Theobald shows that while the French author in his classification upholds certain genera proposed by Theobald

himself and which were originally based almost entirely upon scale structure, certain others of his genera suffer from the application of this class of characters. The main objection to the palpal characters is their difficulty to the student, and, if possible, for convenient use tables for the separation of species should be based upon characters which can be studied without mutilating the specimens. This plea Mr. Theobald makes for the retention of his scale characters, since they can be made out with any compound microscope, and even with a high-power hand lens. Mr. Theobald deserves great credit for the work which he has done with scale characters, but there can be no doubt that the rational classification depends to a greater extent for its generic characters upon such distinctions as have been pointed out by Neveu-Lemaire. It will be rather difficult to draw the line, for example, between the 'narrow curved scales' and the 'broad curved scales' found upon the heads of certain mosquitoes, since there are curved scales which it would be difficult to distinguish as narrow or broad. There is a gradation, in other words, which makes it difficult in some cases to accept them as generic characters.

Mr. Theobald has done a great and lasting service to the medical profession and to the students of biology in producing this elaborate monograph, and deserves the thanks of all classes. The authorities of the British Museum should also be included in this vote of thanks, since they have published the results of his labor in very beautiful form.

L. O. Howard.

*International Catalogue of Scientific Literature.* G, Mineralogy including Petrology and Crystallography. First Annual Issue. Published for the International Council by the Royal Society of London. Vol. XI., 1903 (January). Pp. xiii + 208.

The general character and scope of this international catalogue have already been sketched in this magazine (Vol. XVI., 1902, p. 861). This volume embracing mineralogy, petrology and crystallography is of the same high quality that has characterized the earlier appearing volumes on other subjects. The scheme of classification of the subject catalogue is as follows, the numbers given being the so-called registration numbers by which each section is designated: 0000 to 0070, general, including philosophy, history and biography, periodicals, text-books, addresses, institutions and nomenclature; 10 to 19, general mineralogy, including chemistry, mode of occurrence, economic mineralogy and artificial minerals, etc.; 30 to 32, determinative mineralogy; 40, new mineral names; 50, descriptive mineralogy with alphabetical list of mineral names; 60, geographical distribution; 70 to 73, meteorites; 80 to 87, petrology, including igneous, sedimentary and metamorphic rocks, unclassified rocks and chemical analysis of rocks; 100 to 750, crystallography, including geometrical and mathematical crystallography (105 to 150), crystal structure and growth (200 to 240), physical and optical crystallography (300 to 440), chemical crystallography (500 to 540) and determinative crystallography (600 to 750).

This scheme and a topographic classification of localities is printed in four languages. The catalogue proper is introduced by an authors' catalogue containing 1,072 entries, comprising 53 pages. The remaining 120 pages contain the subject catalogue as above outlined. The catalogue fills a want much felt by all workers in science, and while alterations in the scheme, especially in the subject classification, may suggest themselves later as advisable, there can be only praise for the work accomplished. The fact that larger funds and more complete equipment of the several bureaus will in the future make it possible to keep the catalogue more nearly concurrent with the period whose work it records insures a still greater usefulness for the work.

Charles Palache.

## SCIENTIFIC JOURNALS AND ARTICLES.

*The Popular Science Monthly* for February has for frontispiece a portrait of Professor W. G. Farlow, president of the American Association for the Advancement of Science, while the first article is the address of the late president, Ira Remsen, on 'Scientific Investigation

and Progress.' This is followed by the address of David Starr Jordan, entitled 'Comrades in Zeal,' before the Sigma Xi Society. Edward S. Holden discusses 'The Predecessors of Copernicus,' giving much information about the early astronomers, and J. Madison Taylor considers 'The Conservation of Energy in those of Advancing Years.' Oliver C. Farrington treats of 'The Geographical Distribution of Meteorites' and Charles P. Pettus describes the origin and progress of 'Washington University,' whose fine and harmonious buildings will be a surprise to many. The final article is by G. A. Miller, on 'What is Group Theory?'

*Bird-Lore* for January-February opens with an illustrated article on 'The Black Tern at Home,' by Ernest Thompson Seton and Frank M. Chapman, and this is followed by 'Horned Larks in Colorado Springs,' by E. R. Warren. 'The Christmas Bird Census' comprises records by 78 observers scattered well over the country. There is a second paper, with colored plates, on 'The Migration of Warblers,' by W. W. Cooke, and an interesting prize essay in the department 'For Young Observers.' In the editorial section is a protest against 'humanizing the birds,' and under 'The Audubon Society' there is much of interest.

*The Museums Journal* of Great Britain for January has an article by Benjamin Ives Gilman, 'On the Distinctive Purpose of Museums of Art,' in which the writer takes the ground that there is a marked difference between museums of art and other museums. The function of the art museum is not primarily that of popular instruction, this being of secondary importance to its esthetic influence. The notices of art forgeries contained in the notes should put collectors of paintings and bric-à-brac on their guard.

Professor R. Krause and Dr. M. Mosse, of Berlin, announce the foundation of a new *Centralblatt f. normale und pathologische Anatomie mit Einschluss der Mikrotechnik.*

## SOCIETIES AND ACADEMIES.

### NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

The regular meeting of the section was held on January 25 at the American Museum of Natural History in conjunction with the New York Branch of the American Psychological Association. Afternoon and evening sessions were held, the members dining together between sessions. The program was as follows:

*Primary and Secondary Presentations:* Dr. Henry Rutgers Marshall.

Dr. Marshall in his paper aimed to present evidence that presentations are always new presentations, and that, therefore, images can not be properly said to be copies of impressions, nor can what we call representations be properly said to be duplications of any presentations which have previously existed. His paper was a summary of an article which is presently to appear in *Mind.*

*The Generic Relation of Organic Sensation and Simple Feeling:* Professor Margaret E. Washburn.

*The Universe's Place in Man:* Dr. Francis Burke Brandt.

The paper emphasized the necessity for a fresh start in modern empirical investigation through a critical restatement of the postulates of experience. The starting point of every empirical science, it was contended, is individual conscious experience. The primary datum of individual experience is a perceptive and a conceptive consciousness combined organically in the unity of a personal life existent in a universe of persons. The material universe thus primarily takes its place in man rather than man his place in the material universe, for scientific philosophy has demonstrated beyond criticism, first, that the visible universe always exists primarily in and for a momentary perceptive consciousness limited in space, and second, that the unseen universe is always primarily a conceptive construction whose validity is always verifiable within the realm of momentary perceptive experience. The material universe, whether conceived

phenomenally or existentially, participates in one case in the content, in the other in the being of absolute personality, and as such, so far as individual man is concerned, is the objectification of the conditions of higher individual development.

*Retinal Local Signs:* Mr. Walter F. Dearborn.

This paper was offered as a critique of the first of the three Lotzean hypotheses concerning the nature of the retinal local signs. Experiments to determine the accuracy of the motor impulse, as shown by the ability to fixate directly eccentric visual stimuli forty degrees to the right of the primary line of regard, found an average error of corrective movements considerably in excess of the threshold value of local discrimination for the same part of the retina. These discrepancies between the accuracy of the motor impulse and the delicacy of local discrimination seem to necessitate some modification of the traditional view in regard to the nature of the local signs, or at least in regard to the relative importance of the motor factor.

*Dewey's 'Studies in Logical Theory':* Dr. Henry Davies.

In this paper only the four chapters contributed by Professor Dewey to the above work were considered.

Toward the right understanding of the work two conditions of a historical character must be borne in mind. One of these is the relation of recent logical theory to the Kantian dualism of sense and reason which tended to separate thought from its object. The other is the influence of the evolutionary method, which drives the investigator to study logical distinctions in the light of their genesis in experience.

Both of these conditions exert a profound influence over Dewey's thought. For it is the essence of his contribution to logical theory that he shows that the obstinate manner in which logicians have accepted the Kantian reading of experience is the most fruitful historical cause of the contradictions, *e. g.*, in Lotze's 'Logic' as well as in that of Bradley and Bosanquet. Dewey claims that this is a complete misreading of the thought situation.

On the other hand, common sense and empirical science with their pragmatic and evolutionary method disclose the real situation. Thought is a question of *specific* purposes, *specific* contexts and *specific* conflicts. Common sense and empirical science assume for these specific aims the unity and continuity of experience. The logical problem emerges when this is broken up by an inward conflict into fact and theory, datum and ideatum. The content of thought is just this conflict, which is only a temporary phase of the logical situation, the outcome of which must always be the reestablishment of the original unity in our experience.

It follows from this that logic can not contemplate as its aim a completely rationalized metaphysics. Rather its function is to act as a philosophy of experience, as a *method* by which experience may be advanced towards better and more complete knowledge. But the rectification of experience and the complete correlation of all the functions of experience presuppose a logic of genetic experience. It is Dewey's merit to have pointed this out and to have, in large part, supplied the need in the present work.

*The Distribution of Errors in Spelling English Words:* Professor Robert MacDougall.

Dr. MacDougall made a provisional report upon an investigation of the distribution of errors in spelling English words. These occur characteristically in the latter part of the word, but do not present a continuous increase from beginning to end. The curve of error is an anticlinal having its maximum in the third quarter of the word and its points of origin the initial and final letters, of which the latter is the higher in the scale of errors. Similar relations are presented by the component syllables, fewest errors occur in the initial, most in the median letters. Considered apart from their relation to the termination of the word, the frequency of error in successive letters is found to increase with each remove from the beginning of the word.

*The Ultimate Relation between Magic and Religion:* Dr. Irving King.

Magic and religion can not be legitimately

distinguished on the side of the actual content of their respective practices, nor by using such notions as that of the supernatural, unless they are critically reconstructed with reference to the type of culture in which they are applied. It seems more legitimate to differentiate magic and religion according to the types of situations within which they appear. Some tensions in the experience of the primitive man are merely occasional and appeal to him chiefly as an individual; others are more general and appeal more insistently to the consciousness of the social group. In connection with the former sort of tensions magical practices are developed, and in connection with the latter variety religion differentiates.

JAMES E. LOUGH,
*Secretary.*

BOTANICAL SOCIETY OF WASHINGTON.

THE seventeenth regular meeting of the Botanical Society of Washington was held at the Portner Hotel, January 7, 1904.

Messrs. A. D. Shamel, W. W. Tracy, Sr., Professor C. V. Piper and Professor W. M. Scott were elected to active membership.

At the close of the business meeting the following papers were presented:

*The Identity of American Upland Cotton:* MR. L. H. DEWEY.

The common cultivated cotton of the southern states is known in American botanical literature as *Gossypium herbaceum* L. European authors, especially in recent years, have referred it to *G. hirsutum* L. Nearly all authorities agree that the cotton of southern Asia, cultivated in India since the earliest records, also cultivated in southern Europe and known as the Levant cotton, is *G. herbaceum.* The descriptions of Linnæus do not characterize the species definitely, though 'five-lobed leaves' applies best to *G. herbaceum,* and 'acutely three- to five-lobed leaves' to *G. hirsutum,* but the authors cited by Linnæus state clearly that *G. hirsutum* is the American cotton.

The name *Gossypium herbaceum* has evidently been applied to American cotton as the result of a misidentification by early American authors and the assumption that it originated from seed brought from Europe. American upland cotton is almost certainly of American origin. Both American and Asiatic cottons exhibit a wide variation, but the general characters within the limits of variation are sufficiently constant to mark them with certainty as distinct species. *Gossypium herbaceum* has leaves with roundish or broadly acuminate lobes, yellow flowers purple at the base of the petals, toothed bracts and nearly spherical umbonate five-celled bolls to which the lint tenaciously clings. *Gossypium hirsutum* has acutely lobed leaves, white flowers, turning purple (but rarely with purple at the base of the petals) deeply cleft bracts, and ovate four- to five-celled bolls from which the lint is free at maturity. Tournefourt, in 1700, described it as the 'finest American cotton with greenish seeds'; Linnæus, in 1763, called it *Gossypium hirsutum,* and this is the name by which it should now be known.

*The Influence of Insoluble Substances on the Poisonous Action of Aqueous Solutions on Plants:* DR. RODNEY H. TRUE.

The paper by Dr. True, on the effect exerted on the action of poisonous substances by the presence of insoluble bodies in the solutions, presented in a preliminary way the results of a series of experiments, still in progress.

Finely divided paraffine, quartz sand, filter paper, and other insoluble substances were found to reduce the action of salts of the heavy metals and of certain non-electrolytes by their mere presence. This was explained on the basis of a supposed adsorption of the molecules of the poisonous compound by the surface of the insoluble body. A parallel was pointed out between the rates of growth seen in solutions containing a constant amount of copper sulphate provided with increasing quantity of quartz sand, and the growth rates seen in a series of progressively diluted copper sulphate solutions. The effect was similar in both cases, indicating that the insoluble substance in its essential effect removes molecules or ions of the poisonous materials from the free solution. The bearing of this situation on all physiological problems dealing with the soil was pointed out and the

possibility of an important action in the internal physiology of plants was suggested.

*The Present Confusion Among the Species of Dioscorea:* Mr. W. E. Safford.

Mr. Safford became interested in the classification of the species of *Dioscorea* during his cruises among the islands of the Pacific. On many of them yams are among the principal food staples of the natives, and occur both spontaneously and in cultivation. Many distinct forms occur which have received vernacular names on the various islands, but the delimitation of species and varieties is very difficult. The same species varies under different conditions of light and moisture; leaves vary in shape, pubescence, and relative position on young and old specimens, and, indeed, on different parts of the same plant. Many of the early collectors contented themselves with giving lists of native names together with a brief description of the tubers to which they apply. Many of these names prove to be descriptive, as 'white yam,' 'blue yam,' 'one-head yam,' 'devil yam' and the like. No attempt has been made to bring together the various forms of different island groups for comparison, and no confidence can be placed in existing synonymy.

On the island of Guam the natives have divided the yams into two classes according to the shape of their leaves, calling all those with broadly cordate or orbicular leaves with a deep basal sinus 'Nika,' and those of which the leaves are more or less sagittate or hastate 'Dago.' Gaudichaud, botanist of the Freycinet expedition which visited Guam in 1818, referred the varieties called *Dago* to *Dioscorea alata,* and those called *Nika* to *Dioscorea aculeata.* In Guam the wild Nika ('Nika cimarron,' or 'Gado') differs radically from the cultivated form in having a mass of lateral roots about the base modified into sharp, wiry, branching spines. Whatever may have been the cause of their origin, they serve to protect the sweet farinaceous tuber below. Gaudichaud referred this species to *D. aculeata,* but it proves to be *D. spinosa* Roxb.

Linnæus' descriptions are brief and quite insufficient. Many of them were evidently made from type plants in poor condition, and in some of them a single description included two or more species. According to Sir Joseph Hooker a part of Linnæus' description of *Dioscorea sativa* ('Spec. Pl.,' ed. I., 1033) applies to *D. spinosa* Roxb., to which should also be referred Roxburgh's own *D. aculeata.* The true *D. aculeata* L. is without the basal spines above described, and *D. sativa* L. is a glabrous plant with a terete bulbiferous stem. To the latter species should be referred the *D. bulbosa* of Robert Brown.

In looking over herbarium specimens it becomes apparent that yams can not be studied from dried plants. Points of distinction often lie in the flowers or fruit, which are often wanting in herbaria or are represented by only one sex. Cultivated yams are propagated asexually; and many varieties, like those of sweet potatoes, ginger, *Colocasia,* and other cultivated plants, are seldom seen in flower or fruit. Other species have been differentiated according to the form of their tubers; and these are almost always lacking in herbaria. Still others have been described with reasonable accuracy, but figures of different species have been cited as illustrations.

Sir Joseph Hooker found the species of Indian Dioscoreæ in such indescribable confusion that, after devoting much labor in determining and delimiting them, he had to let them appear in his 'Flora of British India' in a shape most unsatisfactory to himself, saying that he could not hope to avoid errors; that the Roxburghian food-yielding species are for the most part indeterminable, and that the Malayan species are even more loosely described than the Indian; while in the Wallichian collection, which is very complete, the species are often mixed.

It is evident then that food-yielding varieties of *Dioscorea* must be studied on the spot where they are cultivated, and not in market places or in museums. Series of complete specimens of the plants should be secured, showing different parts of the stem, basal and cauline leaves, flowers of both sexes, fruit and photographs of growing plants and tubers attached to the stem, together with specimens in alcohol or formalin of the inflorescence and the tubers themselves.

In this way alone will it be possible to bring together and compare in a satisfactory manner forms from Polynesia, India, the Malay Archipelago, Africa, Australia and America.

Herbert J. Webber,
*Corresponding Secretary.*

FACULTY SCIENCE CLUB OF WELLESLEY COLLEGE.

The meetings of the Faculty Science Club for the current academic year have been of sustained interest. Professor Charlotte F. Roberts spoke in October on the 'Action of Metallic Magnesium upon Aqueous Solutions,' detailing experiments performed in the chemical laboratory, the results of which were published in the *Journal of the Chemical Society.*

The November meeting was addressed by Professor Sarah F. Whiting, on 'The Latest Theory of Electricity and its Historical Development.' This paper was amply illustrated by experiment, and finally some radium salt was exhibited, also photographs taken with it, and its action in discharging electricity.

Professor Irving Fisher, of Yale, was the guest of the club in December, and spoke on 'Sundials, their Different Forms and Mathematical Theory.' He especially described a bronze cylindrical sundial of his own construction, which gives not only local apparent time but that of any standard meridian and sidereal time. This dial is, through President Hazard, placed in the Whitin Observatory.

At the January meeting Miss Alice Wilson Wilcox spoke on '*Pectinatella magnifica,*' detailing her own studies of this form. This paper was illustrated by drawings, photographs and microscopes.

Grace Langford,
*Secretary.*

THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The December meeting of the club was held on the 22d inst., President Turneaure in the chair.

The first paper, by Professor Sandsten, on 'Conditions which affect the Production and Fertility of Pollen,' dealt with a number of interesting questions which have been subjects of research by Professor Sandsten. A week's rain at the time of blossoming of apples was shown absolutely to prevent distribution of pollen and cause an orchard to be barren.

The second paper, by Professor Whitson, on 'The Influence of Climate on Soil,' was illustrated by striking examples of plants grown in soil which had been used for ten years in the university greenhouse, as compared with similar plants which had been grown in the same soil which had been only recently removed from the field. The plants in the first case were enormously advanced, while the comparative analysis of the soils showed the greenhouse soil to be much richer in soluble matter and to have undergone marked nitrification.

The January meeting of the club was called to order on the twenty-sixth at 7:30 P.M. in the physical lecture room of Science Hall, President Turneaure in the chair.

The first part of the evening was devoted to reports of the recent meetings of the science associations. W. H. Hobbs reported on the geology and mineralogy section of the American Association for the Advancement of Science; B. W. Snow on the physics section of the American Association for the Advancement of Science; V. Lenher on the American Chemical Society, E. B. Skinner on the Wisconsin Academy of Sciences, Arts and Letters.

The paper of the evening, 'Some Economic Problems in the Location of the K. L. and J. R. R. in Tennessee,' by W. D. Taylor, was presented in a very interesting manner, being illustrated by lantern slides of the region and of the workings in the construction of the road.

Victor Lenher,
*Secretary.*

THE NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The forty-ninth regular meeting of the section was held at the rooms of the Tech. Union, Massachusetts Institute of Technology, Boston, Friday, January 22, at 8 P.M., with President W. H. Walker in the chair. Forty members were present.

Mr. Maximilian Toch, of New York, pre-

sented a paper on the 'Permanent Protection of Iron and Steel,' in which he discussed the different kinds of coatings used for the purpose, with especial reference to the good effects obtainable by the use of a paint made from Portland cement of a certain definite composition. Lantern slides were shown illustrating the microscopical character of cements of various compositions, and the effects of corrosion on structural iron and steel.

Arthur M. Comey,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### CONVOCATION WEEK.

To the Editor of Science: I, with doubtless many others, feel indebted to you for the clear exposition, in your editorial on convocation week, of certain problems in the policy of the American Association. The purposes of the association to encourage research and specialization and, at the same time, disseminate scientific and useful knowledge among the people, divides the membership of the association now, more than at any time in the past, into two more or less distinct groups—investigators and popular teachers. Under ideal conditions, taste and ability for these two occupations should be perfectly balanced in each individual, but rarely is this the case. With increasing specialization in science, we are approaching more and more nearly to industrial conditions, where production and distribution are the separate functions of the manufacturer and the merchant. These two deal with each other oftenest not directly, but through a middle man. There is, to be sure, a vast difference between knowledge and merchandise, but the similarity in development deserves attention. It must be admitted that at times in the past the two purposes of the association have gone but lamely together. To some lack of community of interest between them, which I grant ought not to have existed, the birth of some of our separate societies was due. If efficiency in each branch were the sole consideration, it would be better to have investigators and specialists in each science in a group by themselves for their serious work, but some point of contact among specialists in the different sciences and with the public at large must be found, or the whole system will fail from too much intellectual in-and-in breeding, on the one hand, if not from lack of popular sympathy and support, on the other. The convocation week meeting of the association, if wisely conducted, can doubtless bring together the meetings of a large number of affiliated societies, and thus effectually emphasize the common ground and common purpose of the sciences, which is now too often forgotten by both scientific societies and scientific men. The function of the association at such a meeting would be largely that of a clearing house, and the second purpose of the association could receive but the scantiest attention. This would be unsatisfactory to what I take to be the larger and more rapidly increasing part of the present membership of the association. I believe, therefore, some ampler provision should be made for this already too much neglected body by a second meeting at a different time of year, preferably in the summer season. It is plain, however, that the most careful judgment and balance must be shown in making up the programs of the two meetings, to meet effectually the double purpose of the association, and still make both meetings attractive, if not of compelling interest, to the whole membership. Aside from such considerations, the financial aspect of two meetings a year may prove to many a vexing one. It may be true that the association can, with its increased membership, carry the financial burden of two meetings; but how about the individual who in most cases is compelled to live on a salary inadequate to his growing obligations? If those who can attend but one meeting a year can be brought to see that their freedom and convenience are better served when they have two meetings from which to choose, the problem will be simplified.

The suggested change of policy seems to me one of such far-reaching importance that it should receive the broadest discussion from the most varied points of view before a decision is attempted. Ernest Fox Nichols.

Columbia University,
February 2, 1904.

JUST now, before the busy scientific men all over the country have allowed the memories of the recent holiday meetings of scientific societies to be covered up with the details of every-day work, is a good time to consider the object of the union of these organizations and how this may be made more effective. For the purpose of reading papers on subjects to which they are devoting their lives and their best enthusiasm, or to discuss the latest information, or to meet and compare notes with men of similar thought and labor, this, I take it, is the impelling motive that brings men together at a scientific association.

That the attendance on the recent meeting of the American Association for the Advancement of Science and affiliated societies at St. Louis was not larger was to be expected, in view of the fact that meetings of those interested in nearly all branches of scientific work have already been announced for next summer in the same city. Many can not sacrifice the time nor bear the expense of more than one visit to St. Louis, and will so time their visits to the fair next summer as to include the session of the scientific meetings. With regard to enthusiasm, and strict attention to the business that brought them together, and in the absence of that sensationalism, which moves every scientific man to shrug his shoulders, the St. Louis meeting was a great success.

The plan that has been inaugurated, of having all societies interested in a common work meet under the same auspices, at the same place, during 'convocation week,' has been carefully considered. That it is satisfactory is attested by the meetings already held under this arrangement; but it should receive the hearty support of every one and the cooperation of all scientific societies. Any subsection or class of specialists has a perfect right to hold a meeting elsewhere at the same time, but though a closer fellowship with men of the same cult may perhaps be attained, the larger benefit of association with those possessed of culture, and who are men of ideas, in other allied or, indeed, widely different subjects, is not attained. It is of as much importance that the horizon be extended as that we knit closer the bonds of fellowship in a limited circle. An annual meeting of affiliated societies brings about just the desired result.

It may be assumed that a large per cent. of those attending the meetings are associated with different educational institutions, and for them a winter meeting will no doubt prove most convenient, when local conditions, such as meetings of state educational and scientific bodies, are adjusted to this condition of affairs. It has been found that a general meeting held during the summer, even if as late as the last week in August, breaks in upon a vacation at the seashore, in the mountains, by the lakes, or seriously interrupts some laboratory investigation or scientific excursion. On the latter account many biologists especially have frequently been unable to attend the meetings.

There can certainly be no valid objection to having semi-annual meetings of sections or of affiliated societies held during the summer at appropriate and convenient localities, but this should not be allowed to interfere with attendance at the larger and more important *annual* meeting, held in the winter at some central and convenient point.

It will, I think, be found that the men of the central west can be depended upon to attend meetings held during convocation week, if they are not obliged to travel over from 500 to 800 miles. Some will double these distances for the sake of the advantages that a meeting of this kind affords. If the men along the Atlantic coast will do as well there will be no lack of attendance. By concerted action and hearty cooperation, then, it is possible to make the annual meeting of scientific societies, even more than it has been for the last fifty years, a center of scientific life and enthusiasm.

E. H. S. BAILEY.
UNIVERSITY OF KANSAS.

As is well known, the American Association for the Advancement of Science used to meet in midsummer and the different professional societies in midwinter. Now the American Association for the Advancement of Science has changed its meetings to winter and the

professional societies, many of them at least, do not feel like giving up their winter meeting. The result has been considerable friction between some of the section meetings and the other societies. The difficulties have not been removed entirely, but are being adjusted by compromises.

It occurs to me that the trouble might be removed in large measure by having meetings of the sections of the American Association for the Advancement of Science in mid-summer. They need not all meet at the same place. In fact it would be better for them not to meet at the same place, as the summer meetings should have for their paramount objects excursions and field trips, and the locality that would be highly interesting to the geologist might have little to attract a chemist or botanist.

Furthermore, the sections by meeting separately could go to smaller places which could not entertain the entire association, and thus whatever good influence these meetings might possess would be more widely distributed. The meetings in the smaller cities would probably have a greater influence than in the large cities, because in the smaller place they would be 'events' that would attract the attention and interest of nearly every one, while in large cities they attract little attention, being lost in the bustle of the city.

This arrangement would enable a greater number of the scientists to partake of the benefits of the meetings, as many could attend the summer meetings in one place who could not attend the winter meeting in another and *vice versa.*

Let us then have the meetings of the sections in the summer in a locality containing points of interest to the section concerned. For instance, Syracuse, with its many objects of geological interest, would make an admirable place of meeting for the geological section. Another summer it could go to the iron district of Lake Superior or Alabama, again to the cave district of Kentucky or Indiana, and so on from year to year.

T. C. Hopkins.

Syracuse University,
January 14, 1904.

To the Editor of Science: Referring to the questions noted in your editorial in a recent number of Science, I beg leave to suggest:

It is more and more apparent that the naturalists of the country are laboring under certain serious disadvantages by reason of which we are likely, unless we are cautious, soon to lose the whole inspiration which should come from organization. In the first place, this is an exceedingly wide country and we are, by the nature of the case, much scattered, unable to meet together in one place without a considerable sacrifice on the part of the greater number, both of time and of money. In the second place, in an effort to better this and for possibly other reasons not here to be discussed, we are at present overwhelmed with a multiplicity of organizations. The botanists, for example, are in this particular no better off than any of the rest.

For the botanists, I beg to offer the following suggestions:

Let us maintain at all hazards the botanical section of the American Association for the Advancement of Science as part of a national organization of the utmost value to the people of this country for educational reasons, if for none other. Then let us have a single Botanical Society of America to have at least two meetings per year, one of which shall always be in connection with the meeting of the American Association for the Advancement of Science. Let the program of Section G consist of two parts, the one to be offered, say, in the forenoon of each day, to be of more popular character, open to all America; the other to be in charge of the Botanical Society, to contain papers of a purely professional character, reports of research work, contributions to knowledge.

In some such way as this, it seems to me, we can preserve the high standard of our association meetings, gain the inspiration which comes from a general assembly, and at the same time not lose sight of the objects sought in the way of popular impulse, encouragement and education.

The Botanical Society might hold as many meetings as it likes, be divided into as many subdivisions as might be deemed convenient,

for purposes of local assembly and fellowship, but always with the understanding that the great meeting of the year should be with the association, which shall shift about in its sessions as heretofore.

THOMAS H. MACBRIDE.

IOWA CITY, IA.

REPLY TO AN ADDRESS: PRESENT STATUS OF SOIL INVESTIGATION.

SOME criticism of Bulletin No. 22, U. S. Department of Agriculture, has appeared recently, the tenor of which is that the authors of the bulletin have proposed new chemical methods for the determination of soil fertility, and that they have concluded that the use of fertilizers is of no value in affecting the yield of crops. These criticisms have generally been copied from Circular No. 72, Agricultural Experiment Station, University of Illinois, in which parts of sentences from Bulletin No. 22 are brought together in an attempt to show a meaning which they do not possess in their proper position. The first paragraph of an 'Explanatory Statement' prefixed to the Circular is as follows:

This address was written for the purpose of calling attention to certain discrepancies in the work of the different prominent investigators in the subject of soil fertility, especially such as have a bearing upon investigations and conclusions touching soil conditions in Illinois. The paper deals particularly with the recently issued and much advertised Bulletin No. 22, from the Bureau of Soils, United States Department of Agriculture, on 'The Chemistry of Soils as Related to Crop Production,' which says that 'practically all soils contain sufficient plant food for good crop yields,' and that 'this supply will be indefinitely maintained.' This is commonly understood and is certainly intended to mean that the use of farm manure, the growing of clover and other leguminous crops, as a source of nitrogen, or the application of bone meal or other fertilizers has little or no tendency toward permanent soil improvement, and that even the effect which they do produce is due very largely, if not entirely, to improved physical condition of the soil, which effect, the Bureau of Soils believes, can be better obtained by 'a simple rotation and change of cultural methods,' and the statement is added that 'the effect due to cultivation is also more permanent than the effect due to fertilizers.'

As a matter of fact, these statements are utterly at variance with the complete context and plain meaning of the bulletin, but they have been copied in the lay publications of this country to such an extent as to call for an explicit denial. That the authors of the bulletin fully recognize the importance of the proper use of fertilizers is made perfectly plain by the following quotations (pp. 58 and 59):

There is no question that in certain cases, and in many cases, the application of commercial fertilizers is beneficial to the crop. The experience of farmers, the enormous sums expended for commercial fertilizers, and the many experiments carried on at the experiment stations prove that under certain conditions fertilizers are very beneficial in increasing the yield of crops. The fundamental idea under all of this work, however, has been that of supplying plant food in an available form; that is, adding to the supply existing in the soil. It is significant that other conditions of growth have so much influence on the yield that in but very few instances, even after long-continued experiments, has it been demonstrated that any particular fertilizer ingredient or ingredients are required for any particular soil, and that even then the effect of the fertilizer varies so greatly from year to year that no specific law has been worked out, even for a particular soil, from which the fertilizing requirements could be deduced in any exact manner.

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In cooperative experiments carried on by Atwater, numerous cases are cited where phosphoric acid is said to be a regulating ingredient and the predominating factor in controlling crop yields one year, while it is more or less efficient in the same soil in other years, and is inefficient in many cases in the same soils in still other years. The same fact is brought out in regard to potash and nitrogen, and it is clearly and unquestionably demonstrated that the effect of fertilizers is dependent upon the season, it being so influential in one season as to be designated as a dominant factor in the yield of the crop, while on the same soil in a different season it has no apparent effect. It is not that the effect is one year greater and the next year less, which might be attributed to the previous application, but it is just as likely to be inefficient one year and the controlling factor the next year as it is to be a controlling factor one year and inefficient the succeeding year.

While it is thus explicitly stated, and it is a matter so notorious as to admit of no question, that crop yields are often affected advantageously by proper fertilizers, it is maintained that such substances can not be held as alone the chief factor in determining yield of crop, since climate, soil management, etc., produce effects of the same order of magnitude as do the fertilizers, and that it may happen that the several effects would nullify one another in any particular season, illustrations almost innumerable being on record.

Attention may also be called to the fact that the bulletin does not attempt to treat specifically of commercial fertilizers, nor of their use in practice, but the matter is brought into the text only as a necessary consequence of the discussion of the crop-producing power of soils. No claim to an exhaustive presentation of this subject was made.

It is also maintained, and the reasons therefor clearly stated, that no scheme of chemical analysis yet proposed can, in itself, determine the fertility or crop-producing power of a soil. A chemical procedure is described, novel in some respects, which the authors of the bulletin used in their researches, but it is made so evident as to allow of no misconception that this procedure has proved and would generally prove as futile as all its predecessors in attempting to show the probable productive capacity of a soil or its fertility. This is not the place to enter into a discussion of the technical reasons for the inadequacy of our analytical procedures to measure or estimate fertility, but it is safe to say that the position taken, in regard to this point at least, is in full harmony with that of the best authorities.* To cite two recent utterances on this point, at the meeting of the Association of Agricultural Colleges and Experiment Station Officers held in Washington last November (1903) Director Thorne, of the Ohio Experiment Station, in describing the results of plot experiments extending over a number of years, stated that it was difficult to see how the results could possibly have been anticipated by laboratory examinations of the soils. At this same meeting Dr. H. W. Wiley, chief of the Bureau of Chemistry, U. S. Department of Agriculture, stated: "When a man sends to me a specimen of a given soil and writes, 'Please analyze this soil and tell me what crops I can grow on it,' I send him word, 'Ask your soil itself what you can grow on it; in that way asking your question directly of the soil, you can get your answer, and in no other way.'" At a later point in this address it was explicitly stated that if chemical methods could be devised for determining the food constituents in soils, different procedures must of necessity be devised for extracting each constituent from the soil, and different procedures again for each crop.

* From the many citations which could be given the following is taken as one of the most conservative: Bailey (Cornell University Agr. Exp. Sta. Bull. No. *119*, 1896) states, 'a chemical analysis of soil is only one of several means of determining the value of land, and in the general run of cases it is of secondary value.'

Hopkins delivered an address at the meeting in Washington already mentioned, and has anticipated the publication of the proceedings, the address having appeared as Circular No. 72, Agricultural Experiment Station, University of Illinois. In it exceptions are taken to Bulletin No. 22, partly through evident misinterpretation of the text; partly through disapproval of the use which the authors have made of the well-known data from the Rothamsted Station, although the validity of the conclusions drawn is in general admitted; and partly because it has been possible on the basis of chemical analysis, to advise the use of fertilizers containing potassium on certain Illinois soils, with improved yield of crop. The relevancy of this last argument is not apparent unless it is meant to imply that the same method of analysis would always lead to as favorable results, a conclusion unfortunately disproved by numerous instances on record. Indeed, it is a matter worthy of notice in passing that such an instance is cited, without explanation, on page 10 of Circular No. 72 of the Illinois Experiment Station. A soil containing according to analysis an enormous amount of nitrogen (67,000 pounds per acre), an abundant amount of phosphorous (2,000 pounds per acre) but what is regarded as a deficient amount of potassium (1,200 pounds per acre) produced no corn when either

nitrogen or phosphorous or both were applied; yielded about the same, 36 bushels when potassium, 40 bushels when potassium and nitrogen or 38 bushels when potassium and phosphorus were applied. But when potassium, nitrogen and phosphorus were all applied, the indications of the analysis were flatly contradicted by a yield of 60 bushels.

In an 'Added Note' to the circular it is stated: "In connection with the discussion which followed the reading of this and several other addresses relating to this general subject at the convention in Washington, the fact was clearly developed that some of the new analytical methods devised by the Bureau of Soils and used in the work reported in Bulletin No. 22, instead of being 'very accurate methods of analysis,' are absolutely untrustworthy." This statement is not in accord with the facts. The only method mentioned in the discussion was that for determining phosphates. The validity of the method itself was not questioned and the discussion was confined to the discrepancy in the solubility of the phosphates in the Rothamsted soils, as shown by the results reported in the bulletin, and those reported on the same soil samples in another publication.* During the public discussion referred to it was distinctly and explicitly stated that the authors of Bulletin No. 22 were aware of the discrepancy between their results and those in the publication cited, that they believed they knew the reasons therefor through work which was being done upon the solubility of phosphates, in the laboratory of the bureau, and that they had satisfied themselves that the results given were substantially correct.

Nevertheless, in the 'Added Note' it is stated that the absolute untrustworthiness of the methods used 'is further established by an examination of the data which are given in the publications referred to,' and a table is submitted in which there is a comparison of the number of pounds of phosphorus per acre, to a depth of seven inches, in the Rothamsted soils, as calculated from the data in the two publications. In this table results are stated, 'reported' by Bureau of Soils, three minutes' extraction with distilled water, whereas the method actually employed and described in detail was to stir the soil in water vigorously for three minutes, then allow to stand twenty minutes before decanting and filtering, and the work of King was cited to show the significance of the time element. Equally inaccurate is the heading to the other column of figures which are stated as 'obtained' after fifteen hours' extraction with dilute acid. As a matter of fact, according to the statement in the paper from which the data were taken, the soils were digested for five hours in a hydrochloric acid solution, which contained enough hydrochloric acid to be a $N/200$ solution when the carbonates of the alkaline earths, etc., were neutralized, and here also the importance of the time element was emphasized by the author of the method. Beyond the inexcusable carelessness of misquoting results and statements in a controversial paper, these inaccuracies are objectionable because purposely stated in such a way as to infer invidious and quite inaccurate comparisons. Moreover, it is not at all clear why the phosphorus as determined in the two investigations should be compared on the basis of an acre surface with a depth of seven inches, for it is inconceivable that any one at this day, and in view of the well-known work of Darwin and others, would suppose that the same identical seven inches of soil would remain at the surface for any considerable period of time.

Following the table, the statement is made that the author of the *Journal* article cited "determined the phosphorus by the absolute gravimetric method of the Association of Official Agricultural Chemists, and there is no reason to doubt the accuracy of the results thus obtained. The Bureau of Soils used a newly devised colorimetric method which evidently gives results about a thousand per cent. above the truth." These statements are incorrect. The procedure of the Association of Official Agricultural Chemists was not followed; but an entirely different one, which is not absolute, but indirect; is not a gravimetric, but a volumetric one; and the accuracy of the procedure which was actually used has not been established by any published work upon it

* *Jour. Am. Chem. Soc.*, *24*, 79, 1902.

The method is described at length (*loc. cit.*, pp. 97–98) and since the author of the circular quotes freely from the paper he is presumably familiar with its contents, and his statements are inexplicable. The absurdity of the statements is also apparent from the fact that the dilute acid digestion is reported to yield one to six parts per million of $P_2O_5$ in the Rothamsted soils, the lower figure being obtained for four out of the seven soils, and supposing the entire solution to be used for the phosphate determination, there would be only from 0.00016 gm. to 0.00096 gm. of phosphoric acid ($P_2O_5$) available for weighing.

It would not be proper, and it is not permitted me, to discuss here the methods or results given in the *Journal* article as the author is a colleague in this department. It seems worth while, however, to call attention here to the work upon which the method used by the Bureau of Soils rests.

This method is the one described by Schreiner* and in the appendix of Bulletin No. 22. It appears to have been first suggested by Lepierre,† was worked out further by Jolles and Neurath,‡ Woodman and Cayvan§ and others. Its value for solutions containing dissolved silica as well as phosphates, a condition existing in aqueous extracts of soils, was critically tested in the laboratory of the Bureau of Soils by Veitch|| and Seidell,** and at the University of Wisconsin by Schreiner.††

The results of these investigators showed the method to be of a very high order of accuracy as well as delicacy. The figures in the published papers of Veitch and Schreiner speak for themselves, and it seems entirely unnecessary to add additional ones here, although a large number of results obtained by the method on solutions of known concentrations are in our possession, and show remarkably good agreements between the results obtained and the known concentrations. The concentrations of phosphoric acid, stated as $PO_4$, involved in these Rothamsted soils was found to be 10.5 to 19.6 parts per million of air-dry soil or within the limits of 2 to 4.5 parts per million of solution actually examined. Veitch has given results for solutions containing from 1 to 10 parts per million and Schreiner from 1.35 to 42.8 parts per million of solution, which leave absolutely no doubt as to the validity of the method for the concentrations involved in the examination of these Rothamsted soils, or the other soils cited in the bulletin.

* *Jour. Am. Chem. Soc.*, *25*, 1056, 1903.

† *Bull. Soc. Chem.*, *15*, 1213.

‡ *Monatsh. Chem.*, *19*, 5.

§ *Jour. Am. Chem. Soc.*, *23*, 96.

|| *Jour. Am. Chem. Soc.*, *25*, 169, 1903.

** Results unpublished.

†† *Loc. cit.*

The papers cited are all contained in readily accessible journals and they have never been disputed or controverted. It seems wiser, therefore, to confine attention to data already published than to add further figures from our own experience, which would merely accumulate evidence, all in the same direction. It is worth while to note, in this connection, that while Dr. Schreiner's investigation was done for and at the instance of the Bureau of Soils, it was actually carried on in the laboratory of the University of Wisconsin in entire ignorance of the work being done by Veitch and Seidell, and before he was acquainted with any member of the laboratory force in Washington or with the work upon which they were engaged.

The statement in the 'Added Note' 'that it has long been common chemical knowledge that water dissolves but the merest trace of phosphorus from soils' is, to say the least, misleading, and in this connection entirely unjustifiable. It must be assumed that the author is familiar with the classic paper of Dyer* in which he proposes the use of his now famous method for digesting soils in a solution of citric acid. In the early pages of this paper Dyer cites some results he obtained by digesting a soil in water. 250 grams of soil in 1,000 c.c. of water gave six parts phosphoric acid per million of dry soil. The soil and solution were in contact for two days before the examination, but no further phosphoric acid was obtained when the solution had acted on the soil for 28 days, so that it is fair to assume that the solution of the phosphoric

* *Jour. Chem. Soc.*, *65*, 115, 1894.

acid was accomplished very rapidly. By changing the ratio of water to soil from two to ten, Dyer found from seven to eighteen parts of phosphoric acid per million of dry soil. In Bulletin No. 22 the average for 147 analyses of a number of types of soil is 7.64 $PO_4$, equivalent to 5.73 $P_2O_5$, and for the Rothamsted soils from 10.5 to 19.6 $PO_4$ equivalent to 7.9 to 11.7 $P_2O_5$, figures entirely comparable with those obtained by Dyer. This question of the solubility of the phosphoric acid of the soil in water has been frequently discussed in the literature since the work of Knop, who used an unreliable method of analysis, and the very interesting replies of Schulze,* Heiden† and others. This early work has been described at length by Johnson‡ and is supposed to be familiar to every tyro in agricultural chemistry.

| Analyst. | Parts $P_2O_5$ per Million of Soil. |
|---|---|
| Jarriges, | 20 |
| | trace |
| Grouven, | 50 |
| | 15 |
| | trace |
| Hoffmann, | 50 |
| | trace |
| | " |
| | " |
| Hellriegel, | 10 |
| | 10 |
| Küllenberg, | 5 |
| Mixter, | 1 |
| Heiden, | 57 |
| | 26 subsoil |
| | 53 |
| | 19 subsoil |
| Eichhorn, | 31 |
| Schulze, | 6 |
| Ulbricht, | trace |
| | 7 |
| | trace |
| | 3 |

The preceding figures obtained by several investigators using varying proportions of water and soil, digesting for widely varying lengths of time, from a few minutes to many days, using generally gravimetric methods of recognized value, will show that the results presented in Bulletin No. 22 are in no way unusual, and that 'merest trace' is without significance until more specifically defined.

Several investigators besides Knop have reported only traces or no phosphoric acid in water extracts of soils, but generally because of the analytical difficulties in determining it rather than as statements of the actual amounts present.

The further reference in the 'Added Note' to Warrington's examination of drainage waters is irrelevant, since it has been perfectly well known since the time of Liebig that draining or leaching a soil does not remove the salts which may actually be in solution in the soil. Agricultural chemists are perfectly familiar with this fact through the classic papers of Liebig, Way and van Bemmelin, as well as others. Moreover, there are quite a large number of figures for drainage and lysimeter waters recorded in the literature which are much larger than that of Warrington, many of them being quoted by Johnson.*

Hilgard presented an address at the meeting in Washington, attacking Bulletin No. 22, and he also has anticipated publication of the proceedings.† Serious consideration can not be given to this paper, however, since the author claims a *non-sequitur* to the arguments of Bulletin 22, on general principles rather than specific instances. He devotes almost his entire effort to a personal attack on the present Chief of the Bureau of Soils, but incidentally expresses his displeasure with agricultural chemists of the country because they use the 'official method' of analyzing soils rather than the one which he proposed a number of years ago.

FRANK K. CAMERON.

WASHINGTON, D. C.

* *Landwirthsch. Versuch-Stat.*, 6, 409, 1864.

† *Annal. der Landwirthsch.*, *45*, 189, 1865.

‡ 'How Crops Feed,' pp. 309 et seq., 1890.

* *Loc. cit.*

† This journal, Vol. XVIII., p. 755, 1903, and *Los Angeles Herald*, Sunday, December 27, 1903.

## WOODCOCK SURGERY.

IN its desire to do nothing by halves, the American public is at present evincing an extraordinary fondness for 'nature books.' This would certainly be most commendable, were

there not evinced at the same time a lack of discrimination as deplorable as it is, in certain respects, inexcusable. We have, indeed, nature writers of every conceivable shade, from the ponderously accurate, scientific-because-incomprehensible, inartistic, biological specialist, through the whole gamut of good, bad and indifferent writers, to those who scruple not to take all manner of liberties with natural history facts in order to make an impression—and a fortune. And the public reads on with patient equanimity without distinguishing sound and critical observations on animal behavior from the drivel in which animals are humanized beyond all recognition.

Any endeavor to disturb such complacency will, perhaps, seem unkind, but it is clearly a duty which no serious student can shirk who has at heart the development of true animal psychology. In an admirable article published in the *Atlantic Monthly* for March, 1903, Mr. John Burroughs called attention to certain abominations in current nature books. He dwelt especially on the unwarrantable humanizing of animals which has become almost a mania with a certain class of writers. Mr. Burroughs's remarks, if anything, were too temperate, as events have shown. One would have supposed that his criticisms of Mr. William J. Long, for example, would have led that gentleman, before publishing further observations on animal behavior, to gain some idea of the value, or rather, lack of value, which serious students attach to anecdotes as evidences of rational endowment in animals. Instead of this, however, he publishes in a reputable and widely circulated journal (*The Outlook,* September 12, 1903) and republishes in book form with illustrations ('A Little Brother to the Bear, and Other Animal Studies') a series of anecdotes which for rank and impossible humanization of the animal can hardly be surpassed. Verily, *quem deus vult perdere prius dementat.*

Although a careful dissection of this whole article, entitled 'Animal Surgery,' would yield no little instruction and some amusement, it will suffice to quote only one of the author's anecdotes with a brief commentary:

"Twenty years ago, while sitting quietly by a brook at the edge of the woods in Bridgewater, Mass., a woodcock fluttered out into the open and made his way to a spot on the bank where a light streak of clay showed clearly from where I was watching. It was the early hunting season, when gunners were abroad in the land, and my first impression was that this was a wounded bird that had made a long flight after being shot at, and that had now come out to the stream to drink or to bathe his wound, as birds often do. Whether this were so or not is a matter of guesswork; but the bird was acting strangely in broad daylight, and I crept nearer, till I could see him plainly on the other side of the little stream, though he was still too far away for me to be absolutely sure of what all his motions meant.

"At first he took soft clay in his bill from the edge of the water and seemed to be smearing it on one leg near the knee. Then he fluttered away on one foot for a distance and seemed to be pulling tiny roots and fibers of grass, which he worked into the clay that he had already smeared on his leg. Again he took more clay and plastered it over the fibers, putting on more and more till I could plainly see the enlargement; he worked away with strange, silent intentness for fully fifteen minutes, while I watched and wondered, scarce believing my eyes. Then he stood perfectly still for a full hour under an overhanging sod, where the eye could with difficulty find him, his only motion meanwhile being an occasional rubbing and smoothing of the clay bandage with his bill, until it hardened enough to suit him, whereupon he fluttered away from the brook and disappeared in the thick woods.

"I had my own explanation of the incredible action—namely, that the woodcock had a broken leg, and had deliberately put it into a clay cast to hold the broken bones in place until they should knit together again; but, naturally, I kept my own counsel, knowing that no one would believe in the theory. For years I questioned gunners closely, and found two who said that they had killed woodcock whose legs had at one time been broken and had healed again. As far as they could remember, the leg had in each case healed perfectly straight instead of twisting to one side,

as a chicken's leg does when broken and allowed to knit of itself. I examined hundreds of woodcock in the markets in different localities, and found one whose leg had at one time been broken by a shot and then had healed perfectly. There were plain signs of dried mud at the break; but that was also true of the other leg near the foot, which only indicated that the bird had been feeding in soft places.

"All this proved nothing to an outsider, and I kept silence as to what I had seen until last winter, twenty years afterwards, when the confirmation came unexpectedly. I had been speaking of animals before the Contemporary Club of Bridgeport, when a gentleman, a lawyer well known all over the state, came to me and told me eagerly of a curious find he had made the previous autumn. He was gunning one day with a friend, when they shot a woodcock, which on being brought in by the dog was found to have a lump of hard clay on one of its legs. Curious to know what it meant, he chipped the clay off with his penknife and found a broken bone, which was then almost healed and as straight as ever. A few weeks later the bird, had he lived, would undoubtedly have taken off the cast himself, by first soaking it in water, and there would have been nothing to indicate anything unusual about him."

Mr. Long virtually claims that a woodcock not only has an understanding of the theory of casts as adapted to fractured limbs, but is able to apply this knowledge in practice. The bird is represented as knowing the qualities of clay and mud, their lack of cohesion unless mixed with fibrous substances, their tendency to harden on exposure to the air, and to disintegrate in water. Inasmuch as woodcocks have for generations been living and feeding in muddy places, we could, perhaps, although not without some abuse of the imagination, suppose the bird to possess this knowledge. But the mental horizon of Mr. Long's woodcock is not bounded by the qualities of mud. He is familiar with the theories of bone formation and regeneration—in a word, with osteogenesis, which, by the way, is never clearly grasped by some of our university juniors. This woodcock has never been hampered by a college training, has never been required to study sections of decalcified bone—has, in fact, never seen a bone, at least to recognize it as corresponding to a part of his own anatomical structure, and yet he divines the functions of the periosteum and the necessity for proper 'setting' of the bony tissue. This wonderful knowledge can not be the result either of experience or of instinct, for it would be as absurd to claim that the same woodcock is continually breaking his legs and has learned to profit by such accidents, as to maintain that woodcocks for innumerable generations past have all broken their legs with sufficient frequency and regularity to lead to the development of such an exalted chirurgical instinct. We are inclined to believe that while the woodcock was waiting for the cast to harden on his leg, his versatile mind was revolving the problem whether even his human observer, Mr. William J. Long, would be capable of attaining to such *a priori* knowledge of the surgery of fractures without ever having seen such a thing as a bone or a cast.

Now, what are the proofs furnished by Mr. Long? First, reminiscences of 'twenty years ago.' A recent apology by Ginn and Company for the existence of Mr. Long's works informs us that the gentleman was born in 1867. He was, therefore, a lad of sixteen when he met that surgical genius among woodcocks. Granting that he was a most unusual and precocious observer, are we to suppose that twenty years can elapse in any human life without distorting and exaggerating the impressions of adolescence? Observe the wavering, nebulous language of the anecdote. The bird was 'acting strangely,' but there was absolutely no proof that his leg was broken. That such was the case is pure 'guesswork' on Mr. Long's part. He 'could see him plainly on the other side of a little stream,' but he was too far away for him to be 'absolutely sure of what all his motions meant.' He 'seemed' to be smearing clay on his leg; he 'seemed to be pulling tiny roots,' etc. Then the language suddenly becomes positive as the unwarrantable inference crystallizes into definite form in the brain of the observer. We can not sufficiently deplore the fact that this *rara avis*

with a vengeance was permitted to disappear 'in the thick woods,' after adjusting and hardening his clay cast. Could the creature have been captured, we venture to affirm that he would have been eligible to a chair of surgery in one of our leading medical schools, and a phenomenally rapid progress of the science would have been insured.

Mr. Long does not rely entirely on the hazy reminiscences of his boyhood. A brace of reminiscing 'gunners' is introduced and another surgical genius among woodcocks, who, though deeply versed in osteogenesis, must have been singularly ignorant of such comparatively simple mechanisms as firearms or he could hardly have come to such an ignominious end as hanging in a market. This bird, unfortunately, had mud on both legs, though only one of them had been injured. It is surprising that Mr. Long supplies so obvious an explanation of the presence of mud on the sound leg. As he seems to set considerable store by this woodcock anecdote, we suggest that in future editions of his work he discard so commonplace an explanation and adopt one more in harmony with the remainder of his story. Thus he might state that the fracture occurred while the bird was sojourning in a country of unusual geological formation. He was unacquainted with the physical qualities of the mud in that particular region, so that before making the cast for his fracture he made an experimental cast for his sound leg in order to test the cohesive properties of the substance.

The heavy artillery of Mr. Long's proof is the concluding reminiscence of a lawyer 'known all over' the vast state of Connecticut. Again, from a dead bird, which in this instance he has not even seen, he not only infers what the living bird had done, but he indulges in some vaticination as to what the bird 'undoubtedly' would have done had he escaped death or, in other words, evolved from his inner consciousness as clear a knowledge of firearms and explosives as of fractures and casts. Since an ounce of prophylaxis is worth at least a pound of cure, it is rather surprising that the wise woodcocks should spend so much time making casts for their broken limbs instead of keeping out of the reach of gunners.

In last analysis the whole fanciful anecdote is seen to be built on the finding of mud on the legs of a couple of dead woodcocks. In both cases the mud had accumulated at a healed fracture, not at all an unlikely occurrence in mud-frequenting birds. In the whole passage one looks in vain for a particle of authentic proof that the woodcock possesses any chirurgical knowledge or skill whatsoever. Before publishing his article, Mr. Long should have consulted his legal acquaintance on the evidential value of boyhood reminiscences and the tales of sportsmen. He seems really to put implicit confidence in all sorts of hunting and fishing yarns, even when they fall from the lips of lawyers known all over the state of Connecticut. The careful reader of the paper can see between the lines the sly, mirthful twinkle in the eyes of some of these old gunners to whom Mr. Long seems to be continually running for confirmation and amplification of his vagaries.

The passage above quoted is a fair sample of not a little of the literature that is being recommended by teachers and publishers as collateral reading for the pupils of the 'nature study' classes of our schools. Such reading is fondly supposed to afford both instruction and entertainment. That it furnishes instruction can be flatly denied, for it lacks truth, the first requisite of instructive reading. It is bad even as fiction. Amusement it undoubtedly furnishes—more, in fact, than the authors contemplate, since it not only titillates the fancy of the boys and girls, but adds to the gayety of comparative psychologists. Those who are attacking the fads of our educational system will find plenty of work awaiting them as soon as they turn their attention to the excrescences of 'nature study.'

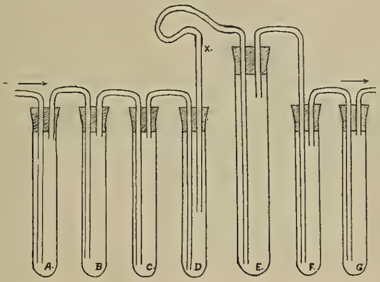
William Morton Wheeler.

## *SPECIAL ARTICLES.*

### RHYTHMS OF $CO_2$ PRODUCTION DURING CLEAVAGE.

The wonderful sequence of morphological changes in indirect cell division is a subject of perennial interest to biologists. The visible changes are generally recognized to be the

expressions of different physiological states. As a means of gaining further insight into the physiological conditions underlying cleavage, I adopted the plan two years ago of testing the susceptibility of the egg at different stages in the first cleavage. Potassium cyanide was used; also lack of oxygen produced by a current of hydrogen. A rhythm of alternate susceptibility and resistance was demonstrated. About ten or fifteen minutes after fertilization the echinoderm egg is very easily poisoned by KCN. The resistance increases from that time to about the time of the first cleavage. A period of susceptibility follows; then another rise of resistance as the second cleavage approaches. Probably this rhythm goes on in each subsequent division. The rhythm to lack of oxygen is similar. This makes it probable that the cell needs oxygen, especially in the period immediately following division, this being the time of nuclear growth and presumably of active synthesis.




During the last summer I have been working on the effects of heat and cold on the dividing egg. The experiments show well-marked rhythms of susceptibility and resistance during each cleavage. The details will be published later.

While pursuing this work it occurred to me that the production of $CO_2$ during cell division might also run in rhythms. The question seemed one of sufficient interest to warrant a careful investigation. Unfortunately apparatus for accurate chemical analysis was not available at Woods Hole. Furthermore, the season had so far advanced that only comparatively small quantities of *Arbacia* eggs were obtainable. It seems best, therefore, to put my results in the form of a preliminary publication, it being understood that the conclusions are tentative and subject to revision on further experimentation.

The apparatus finally adopted is shown in the diagram. Positive pressure forced air in the direction of the arrows. The test-tubes were tightly closed with rubber stoppers. Tubes *A* and *B* contained KOH solution to absorb the $CO_2$ of the air. Tube *C* contained $Ba(OH)_2$ solution and served as an indicator of the efficient action of *A* and *B*. *D* contained *Arbacia* sperm in sea water. *E* contained the unfertilized eggs of a large number of females, in sea water. These eggs had been carefully freed from body liquids and from immature ova by allowing them several times to sink through sterile, filtered sea water in test-tubes or Naples jars. Tube *E* was kept at a constant temperature, usually 23°. Tubes *F* and *G* contained $Ba(OH)_2$ solution whose degree of turbidity constituted an index of the amount of $CO_2$ produced by the eggs and sperm.

Before the experiment began the egg tube was nearly filled with sterile sea water and a current of air free from $CO_2$ passed through for several hours. Tube *D*, which meanwhile had been empty, now received a few cubic centimeters of sea water containing fresh sperm. The eggs, recently washed, were added (with as little water as possible) to the water in *E*. The air was allowed to pass for fifteen or twenty minutes. Then measured amounts of $Ba(OH)_2$ solution were placed in *F* and *G*, the air current being continued. After ten minutes the eggs were fertilized and fresh tubes substituted for *F* and *G*, the first two being securely closed with rubber stoppers and labelled '0.' Every ten minutes fresh tubes were substituted at *F* and *G*, those used during the ten minutes following fertilization being numbered '1,' and so on.

It was found that in ten minutes either before or after fertilization tube *F* became visibly turbid. On standing, a precipitate of $BaCO_3$ formed. Tube *G* showed little or no turbidity or precipitate and, therefore, was usually disregarded. In some experiments

fifteen or twenty-minute periods were used instead of ten-minute periods.

Fertilization of the eggs was accomplished in the following manner: The tube marked $X$ was pushed down into the sperm. The latter was, therefore, immediately forced over by the air pressure and mixed with the eggs. Fertilization was usually very perfect and cleavage, so far as I could determine, went on in a normal way, provided sufficient air was forced through. In one experiment the current of air equalled 25 c.c. per minute. One difficulty experienced was the maintenance of a uniform current. This is a possible source of error.

The experiment was continued usually about two hours, or over two or three cleavages. In one case it was continued until swimming blastulæ had formed.

It will be noted that tubes '0' contained the $CO_2$ produced by both the sperm and unfertilized eggs during ten minutes. A single trial indicated the probability that the larger proportion of $CO_2$ was due to the sperm, probably because of their motility. Tubes '1,' on the other hand, contained the $CO_2$ produced in ten minutes by the fertilized eggs and the *unused sperm*.

It is, therefore, plain that no accurate comparisons of the $CO_2$ production of unfertilized and fertilized eggs, and no measurement of the $CO_2$ produced by the eggs in either condition, can be made until the $CO_2$ production of the sperm has been ascertained. This has not yet been done.

The results so far apparent may be briefly stated. It appeared in nearly all the experiments that an increase in $CO_2$ production occurred in the first ten- or fifteen-minute interval following fertilization. The increase was slight and sometimes could not be detected. Following this came an interval in which the $CO_2$ production was small, visibly less, indeed, in two or three experiments than that of the unfertilized eggs and sperm. This is the mid-period of cleavage, approximating, perhaps, the time of nuclear growth and the early stages of karyokinesis.

The interval during which the eggs were actively dividing into the first two blastomeres (say 45 to 60 minutes after fertilization) was one of active $CO_2$ production. In nearly every experiment the barium hydrate tubes for this time became markedly turbid as compared with any others. After this period of greater $CO_2$ production came an interval of lessened production. In one or two cases a second rise occurred at about the time of the second cleavage. Presumably a regular pendulum swing of increased and decreased $CO_2$ production occurred in the successive cleavages.

If this rhythm proves, on further investigation, to be constant, we have in the segmenting egg an interesting demonstration of the principle that oxygen consumption and $CO_2$ production are not parallel and concomitant processes. Pasteur's yeast experiment shows well that abundant oxygen leads to synthesis and growth, and little $CO_2$ is excreted. Lack of oxygen, on the other hand, means fermentation and a large production of gas. In my experiments the time of maximum oxygen need was apparently one of only moderate $CO_2$ production, while the period of maximum $CO_2$ production was really the period of least demand for oxygen. In other words, the $CO_2$ produced in cleavage seems to be largely the result of splitting or fermentative processes and not of direct oxidation.

Another fact clearly indicated was the increase in $CO_2$ production as development progresses. By the time the eggs have reached the blastula stage, even before they begin to swim, they produce much more $CO_2$ per hour than in earlier stages.

An effort was made to determine the $CO_2$ production quantitatively. At Dr. Mathew's suggestion the $BaCO_3$ in tube $F$ was allowed to settle; measured samples of the supernatant liquid were drawn off and titrated with $m/20$ oxalic acid. Phenophthalein was used as an indicator. Enough was done to indicate the applicability of the method.

As indicated earlier in the paper, I do not consider the results so far obtained conclusive. But by the application of refined methods the problem can be solved. I hope at some future time to work out a modification of Blackman's* or Fletcher's† apparatus which may be appli-

* Blackman, *Philosophical Transactions*, Vol. 186, 1895.

† Fletcher, *Jour. of Physiol.*, Vol. 23, 1898.

cable to the conditions. It will also be necessary to command larger quantities of eggs. In this connection it may be worth mentioning that in one experiment the number of eggs used was estimated at 17,850,000. The method consisted in diluting 1 c.c. of eggs to 100 c.c. and then counting the eggs in ten drops, which equaled .4 c.c. This number seems large and several hundred animals were opened to obtain them; but from a single ripe sea urchin at the height of the season was taken a mass of eggs estimated at 4,600,000. Thus by working at the proper time of the year it will be easily possible to obtain ten times the number of eggs I was able to get for these experiments.

E. P. LYON.

UNIVERSITY OF CHICAGO.

## CURRENT NOTES ON METEOROLOGY.

### CLIMATOLOGY OF CALIFORNIA.

CALIFORNIA has the good fortune to have its climate discussed in considerable detail in 'Bulletin L' of the Weather Bureau (Climatology of California, by Professor A. G. McAdie). In fact this is the most complete tabulation hitherto published of the climatic data of any single state in the union. The 'Bulletin' numbers 270 pages, and is illustrated by means of numerous charts, curves and half-tone views. After a consideration of the controlling factors of the climate (pressure, storms, topography, etc.), there follow tabulated data and brief discussions of the climate of individual localities. Much of the report is naturally tabular. In some cases the tabulation is remarkably complete, as in the case of San Francisco, for example, where the daily rainfall is given for the period January 1, 1865, to March 19, 1902. Persons interested in obtaining meteorological data for California will find this report of great service. A good deal of the present 'Bulletin' has appeared in separate instalments in the *Monthly Review of the California Climate and Crop Service,* and it is a great convenience to teachers, and all others interested, to have the matter collected in one volume. Special reports on frost, fog and thunder-storms are found at the end of the 'Bulletin.'

### SKY COLORS AND ATMOSPHERIC CIRCULATION.

IN *Nature* for December 24, Mr. A. L. Rotch, of Blue Hill Observatory, calls attention to the fact that the occurrence of Bishop's ring and of abnormal glows after sunset, observed at Blue Hill during the past year, was intermittent, and that the respective phenomena occurred at Blue Hill about twenty days later than they did in Switzerland. Assuming that the conclusions are approximately correct, the drift of the dust clouds from central Europe to the eastern United States was at the rate of about thirty miles an hour, or a good deal less than the velocity of the highest clouds. The importance of such studies in connection with the general circulation of the atmosphere is great, and the suggestion made by Mr. Rotch, that a committee, like the Krakatoa Committee of 1884, undertake an investigation of the recent sky colorations, will have the support of all meteorologists. In *Nature* for January 21, Mr. H. H. Clayton calls attention to the steadily diminishing size of the new Bishop's ring around the sun, as determined by measurements made at Blue Hill Observatory.

### WEATHER FOLK-LORE.

UNDER the title 'Weather Folk-Lore and Local Weather Signs,' the Weather Bureau has recently published 'Bulletin No. 33' (8vo, 1903, pp. 153), prepared by Professor E. B. Garriott. The object of the 'Bulletin' is to collect the weather proverbs and sayings that are applicable to the United States, and to combine with these the local prognostics noted by observers of the Weather Bureau at the different stations over the United States. Persons who are interested in weather proverbs will find abundant material in this collection. The proverbs are grouped by subjects, as temperature, clouds, humidity, barometer, etc., often, however, rather haphazardly, as when we find under 'The physiological effects on animal life of changes of pressure' the saying 'smoke falls to the ground preceding rain.' There are several extracts from daily newspapers which, unless the writers of the articles referred to are persons of scientific standing, are out of place in an official publication of

the Weather Bureau. Over half of the 'Bulletin' is taken up with local weather signs for different Weather Bureau stations, these signs being such as the following: winds which bring precipitation; relation of pressure changes to precipitation; directions of high and of warm winds; conditions for frost, etc. In other words, these are type local weather conditions, which will doubtless prove useful to many persons. These local weather signs are illustrated by a series of seasonal charts, showing, for the United States, the directions of the rain winds; the direction of movement of cirrus or cirro-stratus clouds before rain, and the number of hours they appear before rain; the barometer heights preceding precipitation, and the wind direction during periods of high and of low temperature.

R. DeC. Ward.

Harvard University.

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## *ELIZABETH THOMPSON SCIENCE FUND.*

The 29th meeting of the board of trustees was held at the Harvard Medical School, Boston, Mass., on February 5. The following officers were elected:

*President*—Henry P. Bowditch.
*Treasurer*—Charles S. Rackemann.
*Secretary*—Charles S. Minot.

The report of the treasurer, showing a balance of income on hand of $1,788.29, was read and accepted.

The secretary presented reports of progress from the holders of various grants, the work for which is not yet completed, as follows:

| | |
|---|---|
| No. 27. E. Hartwig. | No. 98. J. Weinzirl. |
| 60. F. Kruger. | 99. H. S. Grindley. |
| 65. O. Lubarsch. | 100. H. H. Field. |
| 71. A. Nicolas. | 101. T. A. Jaggar. |
| 73. J. von Kennell. | 102. E. O. Jordan. |
| 94. A. M. Reese. | 103. E. Anding. |
| 96. H. E. Crampton. | 104. W. P. Bradley. |
| 97. F. W. Bancroft. | 106. W. Valentiner. |

Professor Belopolsky having completed and published the work under grant No. 76, it was voted to close the record of that grant.

The secretary reported that 59 applications had been received for the consideration of the board, the total amount asked for being nearly $10,000. Under these circumstances it became necessary to decline, not only applications of minor interest, but also several which in the opinion of the board were of exceptional merit and highly deserving of encouragement and support.

It was voted to make the following new grants:

No. 107. $300 to Professor Morris W. Travers, London, England, for researches on the absolute scale of temperature, by experiments with liquid hydrogen.

No. 108. $150 to Professor Benjamin L. Seawell, Warrensburg, Missouri, for study of the taxonomy and ecology of the organisms of fresh-water lakes, in relation to fish foods and water supplies.

No. 109. $40 to Professor A. Nicolas, Nancy, France, for studies on the embryology of reptiles.

No. 110. $250 to Professor H. S. Grindley, Urbana, Ill., for the separation and purification of the nitrogenous substances of meats.

No. 111. $200 to Professor R. Hürthle, Breslau, Germany, to determine the relation between pressure and the obliteration of circulation.

No. 112. $143 to Professor W. J. Moenkhaus, Bloomington, Ind., for studies on the individuality of maternal and paternal chromatin in hybrids.

No. 113. $50 to S. P. Fergusson, Esq., Hyde Park, Mass., to measure the errors of absorption hygrometers.

No. 114. $300 to Dr. Werner Rosenthal, Erlangen, Germany, for researches on the Lombardy chicken pest.

No. 115. $300 to Professor Henry S. Carhart, Ann Arbor, Michigan, for the preparation and study of Clark and Weston standard cells.

Charles S. Minot,
*Secretary.*

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## *THE ANNUAL REPORT OF THE DIRECTOR OF THE GEOLOGICAL SURVEY.*

The twenty-fourth annual report of the director of the United States Geological Survey, which is now ready for distribution, shows that the several branches of that organization greatly enlarged the scope of their work and increased their activities during the last fiscal year. The period covered is from July 1, 1902, to July 1, 1903, for the work of which congress had appropriated the sum of $1,377,470.

The survey as now organized is divided into five branches: The geologic, topographic, hydrographic, publication and administrative.

The geologic branch includes the divisions of geology and paleontology, of mining and mineral resources and of physics and chemistry. The administration of the division of geology and paleontology was in the hands of the geologist in charge of geology, while scientific supervision rested with the chiefs of sections. The various sections included those of areal geology, Pleistocene geology, pre-Cambrian and metamorphic geology, petrology, economic geology of metalliferous ores, economic geology of non-metalliferous minerals and paleontology. A new section was created during the year—that of petrology. The petrographic laboratory maintained in connection with this section has probably no equal in the quality or the rapidity of its work.

A new feature of the work of the division of geology and paleontology was the preparation and publication of a bulletin entitled 'Contributions to Economic Geology, 1902,' which is intended to be the first of an annual series.

From the appropriation of $163,700 for geologic work allotments were made for 47 field parties, which were sent to all parts of the country. In addition to this, $14,000 was appropriated for the paleontologic work of six other parties. Brief accounts of the results accomplished by each party are given in the report.

Under authority of an act of congress making an appropriation of $60,000 for a continuation of the investigation of the mineral resources of Alaska, five parties were actively engaged in field work during the summer of 1902. A somewhat detailed account of the investigations made by these parties is given in the report.

The principal work of the division of mining and mineral resources is the preparation of the annual report on the mineral resources of the United States, although considerable time is devoted to answering technical inquiries. At the request of the director of the census, the schedules of inquiry of the twelfth census in regard to mining were included with the statistical cards annually sent out by the survey. The returns were transmitted through the Geological Survey to the Census Office, thus affording both offices the benefit of cooperation.

The division of physical and chemical research made 225 analyses of rocks and coals, and 443 qualitative determinations of minerals during the year. A research into the action of ammonium chloride on silicates was finished. Experiments were made upon methods for the analysis of cements. The experimental work of the physical laboratory related mainly to the behavior of the rock-forming minerals and analogous but somewhat simpler chemical compounds at high temperatures. Experiments upon the linear force exerted by growing crystals were also continued.

Near the close of the fiscal year, the topographic branch was reorganized for administrative purposes into two divisions, one of topography and one of geography and forestry. The division of topography now includes three sections: The eastern and western, and a third section, subordinate to the other two, which is called the triangulation and computing section. A federal appropriation of $309,200 was spent on the work, besides an additional sum of $90,000 allotted by various states for cooperative work.

The year's work of the division of topography may be summarized as follows: Two base lines were measured; primary azimuth observations were made at 4 triangulation stations; 395 triangulation stations were occupied or located; 1,487 miles of primary traverse were run; 36,275 square miles were covered by detailed topographic mapping, this area being distributed through 36 states and territories; 29,160 miles of levels were run; and 1,826 permanent bench marks were established, and at each of these an iron post, a bronze or aluminum tablet, or a copper or aluminum plug was set in place. In connection with the Alaskan surveys, about 20,080 square miles were mapped topographically. About 45 miles of the boundary of the Bighorn Forest Reserve of Wyoming were surveyed and marked with special iron posts,

this work completing the survey of the reserve; also 154 miles of the boundaries of the Black Mesa Forest Reserve and 12 miles of those of the Mount Graham Forest Reserve of Arizona were surveyed and similarly marked. In the office 97 atlas sheets were completed and the entire revision and redrafting of the large topographic wall map of the United States was commenced.

The division of geography and forestry was instrumental in making an agreement between the representatives of the farming industry and the sheep industry in Utah, to the effect that the entire mountain region of Utah, which constitutes at present the summer range for sheep, be reserved; that in such portions of these reserves as contributed to the water supply of the agricultural settlements sheep grazing be prohibited; that the remaining portions of the reserves be allotted to the various sheep owners for extended periods, and that the number of sheep to be grazed upon a unit of area be restricted far below the present number. About 7,500 square miles of forest reserves were examined during the season. The appropriation for this work amounted to $130,000.

The funds available for the work of the division of hydrography were doubled by the appropriation act of June 28, 1902, and the operations under the reclamation law were entrusted to the officials of this division. As a consequence, it became necessary, for administrative purposes, to create a separate branch of the Geological Survey. This is known as the hydrographic branch, and includes the work of the division of hydrography and also that of the reclamation service, organized to carry on the surveys and examinations authorized by the reclamation law. The proceeds of the sale of public lands in the western states and territories, which were set aside to create a fund for this purpose, amount to between $3,000,000 and $4,000,000 a year. Preliminary investigations made to show the extent to which the arid lands can be reclaimed by irrigation have been carried on by the Geological Survey for many years. At the beginning of the fiscal year the various engineers who had previously been engaged in these investigations were provided with added facilities for extending the work and carrying on to construction the projects that were considered feasible. Surveys and examinations were made in the states of Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington and Wyoming.

A division of hydrology has also been added to the hydrographic branch, the purpose of which is to study geologic conditions governing the occurrence of underground waters. Another feature of this branch is the division of hydro-economics, of which the chief raison d'être is the investigation of the equality of water and its effect on various industries.

Many interesting details are also given in this report concerning the work of the publication and administrative branches of the survey. Significant of the amount of matter published by the survey is the statement that 20,756 pages of manuscript were edited during the year and 257 atlas sheets and special maps were engraved.

This report is published for gratuitous distribution and may be procured on application to the director of the Geological Survey, Washington, D. C.

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## *EMIL ALEXANDER DE SCHWEINITZ.*

The Medical and Dental Departments of Columbian University have passed the following resolutions in memory of the late Dr. de Schweinitz:

A great calamity has befallen the medical and dental departments of the Columbian University in the death of Dr. Emil A. de Schweinitz, professor of chemistry and toxicology and dean of the medical faculty.

Dr. de Schweinitz became professor of chemistry in 1893, and four years thereafter (1897) he was appointed dean of the medical faculty. He filled both positions with marked ability until his death on February 15, 1904.

Not only was he admired and beloved by the students for his ability as a skillful teacher, both in the lecture room and laboratory, but his gentle method and kindly interest in their welfare won for him their devout regard and unlimited esteem.

In his work as dean of the medical faculty he displayed unusual executive ability. In the equipment and internal arrangement of laboratories for the new college building he labored with untiring industry, care and skill; and in the establishment of a hospital for the medical school (for which many of us worked conjointly) it may be safely said that in the original design of this institution the leading spirit whose persistent and energetic efforts became a prime factor in the development of the enterprise, and whose never-failing hope encouraged those of us who were inclined to despond, was the progressive and unrelenting spirit of Dr. de Schweinitz.

In thus recording our appreciation of his valued services to ourselves and our university, we must not neglect also to join with the world of scientific medicine at large in commending his important labors in the domain of original research. His work in bacteriology, in the investigation of tuberculosis and other infectious diseases both in men and animals, has won for him deserved distinction and renown.

Cut off suddenly in the prime of his manhood and professional usefulness, we devoutly mourn his untimely end. In his demise we have lost a friend, counselor and companion whom we had learned to love, honor and admire.

We offer to his bereaved relatives our tenderest sympathy.

## *SCIENTIFIC NOTES AND NEWS.*

THE American Institute of Electrical Engineers held its annual dinner in New York on February 11, at the same time celebrating the fifty-seventh birthday of Mr. Thomas A. Edison. The president of the institute, Mr. J. B. Arnold, made the opening address. Mr. Edison was unwilling to make a speech, but replied by sending a telegraphic message through an installation placed in the room. Addresses were made by Professor A. E. Kennelly, of Harvard University, Professor Cyrus F. Brackett, of Princeton University, Mr. Joseph B. McCall and Mr. C. L. Edgar. The deed of gift of the Edison Medal, for which about $7,000 had been collected, was presented to the institute by Mr. F. Insull. Many congratulatory messages were read, including the following from President Roosevelt: I congratulate you as one of the Americans to whom America owes much; as one of the men whose life work has tended to give America no small portion of its present position in the international world.

THE centenary of the death of Kant was commemorated on February 12 by the university and the town of Königsberg. A tablet was unveiled by the Prussian minister of education, Dr. Studt, who made a commemorative address. The town of Königsberg has appropriated $2,500 for the establishment of a philosophical prize. A collection of Kantiana was placed on exhibition. The British Academy has also held a celebration at which an address in honor of Kant was made by Dr. Shadworth Hodgson. At Columbia University Dr. Felix Adler gave a commemorative address.

A COMMITTEE has been formed to prepare a medal in honor of the late Professor A. Cornu, the eminent physicist.

DR. EMIL FISCHER, professor of chemistry at Berlin, has been made a knight of the Prussian order 'Pour le merite.'

THE Turin Academy of Sciences has divided the Ballauri prize of about $6,000 between Signor Marconi and Professor Grassi, and has awarded the Brasso prize of about $1,600 to the Duke of the Abruzzi.

THE University of Edinburgh has awarded the Cameron prize in practical therapeutics to Professor Niels R. Finsen, M.D., of Copenhagen, in recognition of his pioneer work in connection with the application of light rays to the treatment of disease.

THE board of control of the Naval Institute has awarded the annual prize for the best essay to Lieut. S. P. Fullenwider, U.S.N. The subject was 'The Fleet and its Personnel.' The prize is $200 and life membership in the institute.

MR. JAMES GAYLEY has been elected president of the American Institute of Mining Engineers.

DR. EDWARD COWLES has resigned the superintendency of the McLean Hospital, at Waverly, Mass., where much excellent work in psychiatry has been accomplished under his direction.

MR. W. C. NASH, superintendent of the Magnetic and Meteorological Department of

Greenwich Observatory, has retired in accordance with the rules of the admiralty service. He has been connected with the observatory for forty-eight years.

Professor Marston T. Bogert, of Columbia University, was injured by an explosion in his classroom on February 20, while making a demonstration to his class in chemistry. It is expected that he will be confined to the house for about two weeks.

Bertha Stoneman, D.Sc. (Cornell, '96), who has for the past six years been professor of botany at the Huguenot College, Wellington, Cape Colony, is on her way to America on leave of absence.

Margaret C. Ferguson, Ph.D. (Cornell, 1901), instructor of botany at Wellesley College, delivered a lecture before the Boston Society of Natural History, on February 3, on 'The Development of the Gametophytes, Fertilization and Related Phenomena in Pines.'

Dr. Emil Kraepelin, of the University of Heidelberg, has gone to the Dutch East Indies to study insanity among the natives.

Professor Wilhelm Uhltoff, professor of ophthalmology at Breslau, has been appointed secretary for the next meeting of the German Men of Science and Physicians.

Dr. Karl Burckhardt, formerly geologist in the Museum of La Plata, has been appointed chief geologist of the Geological Survey of Mexico.

Dean Bovey and Professor Durley, of the faculty of applied science of McGill University, are visiting engineering schools in the United States with a view to the new railway department at McGill.

According to the New York *Evening Post* the official delegates to the sixth annual conference of American Universities were as follows: Clark University, President Hall; University of Michigan, Professor Richard Hudson; Johns Hopkins University, President Remsen and Dr. Gilman; Leland Stanford, Jr., University, President Jordan and Instructor A. H. Suzzalo; University of California, President Wheeler, Professor C. M. Bakewell and Dr. Irving Stringham; University of Pennsylvania, Professors Penniman and Newbold; Cornell University, Professor Thomas F. Crane; University of Wisconsin, Professor D. C. Munro; Columbia University, President Butler, Professors Smith, Carpenter and Perry; the Catholic University of America, Dr. George M. Bolling; Harvard University, President Eliot; Princeton University, President Wilson, Professor Andrew F. West, Dean Fine and Professor Hibben; University of Chicago, President Harper, Professors Paul Shorey and A. W. Small; Yale, President Hadley, Secretary Stokes and Professor Lounsbury.

Dr. Emil Alexander de Schweinitz, director of the Biochemic Laboratory of the U. S. Department of Agriculture and dean of the Medical Department of Columbian University, well known for his contributions to bacteriology, died at Washington on February 15, in his thirty-ninth year.

James A. Skilton, a writer on social questions and a student of Herbert Spencer, died in Brooklyn on February 19, at the age of seventy-five years.

Dr. Edward John Chapman, from 1853 to 1895 professor of mineralogy in the University of Toronto, died at the beginning of February, at the age of eighty-three years.

Dr. William Francis died on January 18, at the age of eight-five years. He was a member of the printing and publishing firm of Taylor and Francis and had been for more than fifty years one of the editors of *The Philosophical Magazine*. He had translated and abstracted many papers on chemistry and physics.

M. Firmin Bocourt, formerly curator of the Paris Museum of Natural History, died on February 4, at the age of eighty-five years. His connection with the museum began in 1834, and on its behalf he made scientific journeys to Siam, Mexico and elsewhere, being known especially for his work on the reptiles. The deaths are also announced of Baron de Ujfalvy, professor at the University of Paris, known for his researches in anthropology and his travels in central Asia, and of Dr. Luigi Barbera, professor of philosophy at the University of Bologna.

SENATOR BARNES has introduced a bill in the New York legislature appropriating $5,000 to establish in the State Prison Commission's Department a laboratory for the study of criminal, pauper and defective classes. A director of the laboratory is to be appointed by the governor at a salary of $3,000.

THE second International Congress of Philosophy will be held at Geneva from the fourth to the eighth of September of the present year. The congress meets in five sections—the history of philosophy, general philosophy and psychology, applied philosophy, logic and philosophy of the sciences and history of the sciences, the last named being at the same time the third International Congress of the History of the Sciences. The subjects announced for the general sessions are 'The place of the history of philosophy in the study of philosophy,' the definition of philosophy, the individual and the group, and final causes in biology and neo-vitalism. The honorary president of the congress is M. Ernest Naville, honorary professor of philosophy at the University of Geneva, and the president is M. J. J. Gourd, professor at the university. The general secretary to whom communications should be addressed is Dr. Ed. Claparedède, 11 Champel, Geneva.

A CORRESPONDENT writes that 'The Order of the Eshai' is a recent scientific organization whose membership consists of those who earnestly and seriously have been and are participating in the study of the paleontology and geology of the sedimentary formations of New York state. The order's monogram is a combination of the letters N and Y, slightly inverted, which form the Russian letter *eshai,* and hence this word has been used as the name of the order. One section is composed of the 'Immortales' or those who have toiled and who now have ceased from their labors, and there are two other sections composed of living members. The keeper of the rolls is Dr. John M. Clarke, state paleontologist of New York.

THE Johns Hopkins Press announces the publication of the lectures on 'Molecular Dynamics and the Wave Theory of Light,' given by Lord Kelvin at the university in October, 1884, and based on Mr. A. S. Hathaway's stenographic report; twelve appendices on allied subjects are added by Lord Kelvin.

A MEETING of gentlemen interested in astronomy was held at Edinburgh, on January 9, to make arrangements for resuscitating the Astronomical Institution, originally founded in 1812.

THE report of the meeting of the Zoological Society of London held on January 19, 1904, contains the following announcement: "An 'Abstract of the Proceedings of the Zoological Society of London' is published by the Society at 3 Hanover Square, London, W., on the Tuesday following the date of meeting to which it refers. It will be issued, free of extra charge, to all fellows who subscribe to the publications along with the 'Proceedings'; but it may be obtained on the day of publication at the price of sixpence, or, if desired, sent post-free for the sum of six shillings per annum, payable in advance." This new publication, which has started with the year 1904, is not the same as the privately distributed reports of the meetings, which will be continued as heretofore. The 'Abstract of the Proceedings' will, we understand, be a small octavo of about eight pages, and will include abstracts of the papers read, which such authors as care to publish preliminary and more or less intelligible descriptions of their new species will be at liberty to use for that purpose. We presume that the editor will not insert in the 'Abstract' brief diagnoses of any new species of which the author has not already supplied a complete and proper description, accepted by the society for ultimate publication *in extenso.*

THE Biological Society of Washington has arranged for five Saturday afternoon illustrated lectures to be given in the United States National Museum. The program of lectures is: February 20, 'The Exploration of the Deep Sea,' C. H. Townsend; February 27, 'The Living Forest,' Gifford Pinchot; March 5, 'A Naturalist's Winter in Mexico,' E. W. Nelson; March 12, 'The Evolution of the Horse,' Henry F. Osborn; March 19, 'The

Coast Region of Alaska, its Fiords, Glaciers and Volcanoes,' C. Hart Merriam.

## UNIVERSITY AND EDUCATIONAL NEWS.

Mr. J. Ogden Armour has given $250,000 to the Armour Institute of Technology for an athletic field.

Mr. John A. Creighton has given a further sum of about $250,000 to Creighton University, a Catholic institution at Omaha, Nebr.

The Liverpool city council has decided to grant £10,000 to the university during 1904, on condition that the council nominate from time to time some person to inspect the work of the institution; that the university make an annual report to the council of its work, including a statement of accounts; and that not less than £1,000 of the grant be devoted for Liverpool scholarships and for the payment and remission of fees. It is intended to make the grant an annual one.

Lord Strathcona has given $20,000 to Manitoba University to extend its scientific work.

Mrs. Winbolt has offered to the University of Cambridge £500 to found an annual prize in civil engineering in memory of her late husband, Mr. John Steddy Winbolt, M.A., Trinity College.

The new Laboratory of Hygiene in the University of Jena was dedicated on January 24.

Dartmouth Hall, the oldest building of Dartmouth College and one of much historic interest, has been destroyed by fire. The loss of $25,000 is partly covered by insurance. The trustees have already resolved to rebuild the hall in more permanent material at a cost of $250,000. West College, Colgate University, has been damaged by fire, the biological and geological departments suffering especially. Several buildings belonging to the Johns Hopkins University were destroyed in the recent fire. They were, of course, insured, but the amount of loss to the university is not at present known. It is said that property to the value of $1,300,000 belonging to the Johns Hopkins Hospital was destroyed. This was insured, but there will be a large curtailment in revenue until the property can be rebuilt.

Attorney-General Cunneen holds that the land in the Adirondacks, to which Cornell University took title for the purpose of a College of Forestry, has now become the property of the state, and is a part of the forest preserve. The attorney-general also holds that the contract between Cornell University and the Brooklyn Cooperage Company concerning the cutting of timber from this land is in violation of the constitution, and void.

A correspodent writes to the London *Times*, in view of recent developments at Oxford and Cambridge, that it is interesting to learn that the Cambridge Union Society has decided by a majority of 87 votes to 70 'that this house would regret the abolition of compulsory Greek in the previous examination.' This expression of undergraduate opinion appears the more significant when it is remembered how small a proportion of the members of the university are professedly classical students. Last year of the 400 students who passed the first parts of the various examinations for honors only 90 were classical men.

Dr. William C. Sturgis, formerly mycologist of the Connecticut Agricultural Experiment Station, has been appointed lecturer on botany at Colorado College, Colorado Springs.

Dr. H. K. Anderson, Caius College, Cambridge, has been appointed university lecturer in physiology in succession to Dr. Langley, appointed to the professorship.

Dr. Henry Kenwood has been appointed professor of hygiene at University College, London, in succession to the late Professor W. H. Corfield.

Dr. E. P. Wright has resigned the chair of botany at Trinity College, Dublin.

Signor Boccardi, late assistant in the Observatory of Catania, has been appointed professor of astronomy and director of the Observatory of the University of Turin.

Dr. Benno Erdmann, professor of philosophy at the University of Bonn, has been called to Tübingen.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 4, 1904.


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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.


## *THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

### *SECTION D—MECHANICAL SCIENCE AND ENGINEERING.*

THE work of Section D of the American Association for the Advancement of Science is in mechanical science and engineering. The section devotes itself to showing the advances which recently have been made in the principles and applications of science in regulating and using the forces of nature. The papers which are presented usually deal with what are commonly known as the applied sciences, more particularly with those which are based upon physics and chemistry. Under electricity are included its generation, adaptation and use on a commercial scale. Under heat are included such practical questions as the generation and use of steam. Under chemistry are included the combustion of coal and other fuels, and the production and use of gas for heating, forging and annealing, and for the generation of power in gas and oil engines; while in the allied science of metallurgy the problems of the mining engineer and metallurgist of iron and steel are included. Under hydraulics we find a long list of problems, the advancement of which has been rapid in recent years in the utilization of the results of the work of the sun as a heat agent, and in controlling this same transmuted heat energy when it manifests itself in swollen streams.

The section is to be congratulated on having had as its chairman Vice-President Calvin M. Woodward, of St. Louis, who is

well known in that city as professor of applied mathematics at Washington University, and as the originator of the St. Louis Manual Training School. Throughout the country he is equally well known as 'the apostle of manual training' and as one of the leading educators of the world; his reputation and position in the community enabled him to be a most efficient vice-president.

Professor J. Burkitt Webb, of Stevens Institute, at Hoboken, N. J., was elected as councilor, and Professor George W. Bissell, of Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa, was elected a member of the general committee. Professor William Kent, of Syracuse University, Syracuse, N. Y., was elected member of the sectional committee for five years. The sectional committee consisted of Professor Clarence A. Waldo, Purdue University, Lafayette, Ind., vice-president 1903; Mr. Elwood Mead, Department of Agriculture, Washington, D. C., secretary, 1903; Professor Calvin M. Woodward, Washington University, St. Louis, Mo., vice-president, 1904; Professor W. T. Magruder, Ohio State University, Columbus, Ohio, secretary, 1904–8; Professor Mansfield Merriman, Lehigh University, South Bethlehem, Pa.; Professor J. Burkitt Webb, Stevens Institute, Hoboken, N. J.; Professor H. S. Jacoby, Cornell University, Ithaca, N. Y.; Professor H. T. Eddy, University of Minnesota, Minneapolis, Minn., and Professor William Kent, Syracuse University, Syracuse, N. Y.

### VICE-PRESIDENT'S ADDRESS.

The vice-president's address was delivered by Professor Clarence A. Waldo, professor of mathematics at Purdue University, Lafayette, Ind., on the subject of 'Engineering and Mathematics.' It was a statement of the great influence of the engineering colleges upon the teaching of mathematics, and was a strong plea for the rationalization of mathematics and especially for engineering students, and also for illustrating the reality of mathematical formulæ and expressions by examples drawn from engineering practise. By this means it will be found that the student will perceive the utility of mathematical applications earlier in his course, and will not be studying the subject for reasons of either blind faith or stolid obedience. As the paper has already been published in the columns of SCIENCE, we gladly refer the reader to the address itself.

### EXCURSIONS.

The section met for the presentation and discussion of papers on Tuesday, Wednesday and Thursday mornings and on Wednesday evening. Tuesday afternoon was spent in an excursion under the auspices of the St. Louis Engineers' Club, to the Eads Bridge, and by special train to the Union Station to inspect the changes now being made in its terminal facilities. The members of the section availed themselves of the kind invitation of the managers of the Louisiana Purchase Exposition, and visited the exposition grounds on Thursday afternoon, where, after luncheon, they inspected the extensive buildings and grounds, and the machinery which was being installed.

### PAPERS.

Professor A. S. Langsdorf, of Washington University, presented a paper giving 'Graphic Methods for Determining the Equations of Experimental Curves' and giving means for fixing upon the type of equation to be used and of evaluating the constants of an equation which represents a curve found experimentally. Parabolic, hyperbolic, logarithmic and periodic curves are treated by his method. The paper will probably be published in the *Journal of the Association of Engineering Societies.*

Professor J. L. Van Ornum, of Washington University, St. Louis, Mo., described the results of his experiments on 'The Fatigue of Cement Products.' In his experiments he made tests of cubes and prisms of neat Portland cement, and of concrete, applying different loads at the rate of about four times per minute until rupture ensued, and plotting a curve of results showing the number of repetitions necessary to cause rupture when the load was a given per cent. of the ultimate static strength. The results of the tests of cubes of neat cement show that repeated loads, less in intensity than the ultimate strength of the material, will cause failure. The number of repetitions necessary to produce this effect increases very rapidly for loads less than 65 per cent. of the ultimate strength, and seems to become infinite at about 50 per cent. value. For example, 180 repetitions of the load of 80 per cent. of the ultimate static strength are sufficient to cause rupture. Four hundred repetitions of the 70 per cent. load, or 1,000 repetitions of the 62 per cent. load, or 1,700 repetitions of the 60 per cent. load, or 4,000 repetitions of the 56 per cent. load, or 5,000 repetitions of the 55½ per cent. load, will do the same. The same general law applies equally to concrete. The above results with cement and concrete are, therefore, similar to those obtained by Woehler on iron and steel. The modulus of elasticity of cement and concrete is greatly reduced in value under the influence of repeated loads of the intensities indicated. Prisms $5'' \times 5'' \times 12''$ high were used in this work. The paper will be printed in *The Transactions of the American Society of Civil Engineers.*

A paper on 'The Design of Steel Concrete Arches,' by Professor E. J. McCaustland, of Cornell University, Ithaca, N. Y., was read in his absence by his colleague, Professor H. S. Jacoby. The author calls attention to the lack of clean-cut, definite knowledge as to the action of steel combined with concrete under stress, and particularly in an arch ring subject to moving loads, and states that arches are built with factors of safety ranging probably all the way from 3 to 150. He is of the opinion that we do not so much need new theories as we do an extension of our practical knowledge of the mechanical properties of concrete. He gives an abstract and discusses a graduating thesis on the subject by Mr. W. S. Edge. After briefly stating the theory which formed the basis of the investigation and describing the details thereof, he summarizes Mr. Edge's conclusions as follows: (1) that the graphic method of solution is as accurate as is justified by our knowledge of safe unit stresses in concrete; (2) that an arch ring designed for thrusts due to uniform live loading will be too thin at the haunches to resist stresses due to eccentric loads; (3) that in large spans it is more accurate to use Cain's method of subdividing the arch ring, since it gives, in general, results for thrusts which are about two per cent. greater than will be given by dividing the arch into equal horizontal sections; (4) it is better not to try to use a modified semi-ellipse for an earth-filled arch when the rise is less than one sixth, or possibly one eighth of the span, as the equilibrium curve flattens it too much at the haunches. It is better to take full advantage of the rise by making the arch linear from crown to springing, thereby reducing the crown thrust. (5) The maximum bending moment is not produced by a live load covering one half of the bridge. For the crown section the bending moment is the greatest when the load is about three fifths on the bridge. The greatest positive moment, however, occurs with the arch practically one half loaded. The greatest negative moment occurs when the arch is three fifths loaded. As the result of designing

about fifteen arches, Mr. Edge suggests a method of procedure which he has found to be the most simple, and hopes that some one else will be interested in extending the investigations. The paper will probably be published in the *Transactions of the American Society of Civil Engineers*.

Professor Henry S. Jacoby then gave an account of 'The New Features and Tendencies in Bridge Engineering' which he had observed in his very extensive bridge inspection tours which he has had the privilege of taking during the sabbatical period which was granted to him by Cornell University. He noted the increase in the use of plate girders up to those of 128 feet 4 inches from center to center of supports; that the present tendency in railroad bridge construction seemed to be to get rid, so far as possible, of the overhead portions of bridges; that riveted trusses were now built in spans up to 230 feet; that the length of panels had now been increased to 37 feet, and mentioned bridges over the Monongahela and Allegheny Rivers of the Pratt type, with curved upper chords having only 11 panels in 417-foot spans. The maximum span of simple trusses is still the same as it was ten years ago, the record being held by the Louisville bridge of 546 feet 6 inches. The Pratt truss seems to be in the ascendency in both riveted and pin construction. The author stated that the majority of the masonry now being constructed by the railroads, with one notable exception, is of concrete, and that concrete arch bridges had been built with spans up to 130 feet. Professor Jacoby has evidently improved his opportunities during the past year, and his work as an instructor must of necessity be correspondingly benefited by the opportunities which he has accepted for studying bridges in the drawing-room, in the shop, in the field and in use.

The next two papers presented were from the Ohio State University, at Columbus, Ohio. The first one was by Professor Wm. T. Magruder, and described 'An Hydraulic Micrometer Caliper' which was presented for inspection to the section. This caliper consists of a bronze graduated circle sixteen inches in diameter which is secured to the end of a hydraulic drum connected to a stand-pipe, and so that it can be rotated around its axis. Cross-screws, both radial and axial, are carried by the revolving ring so that pointers fixed in the ends of the axial screws can be brought into contact with the surface of a jet of water issuing from the orifice, and so that by means of a scale on the screws all the coordinates of the jet can be obtained for a distance of six inches or more from the entrance to the orifice.

Professor James E. Boyd and Professor Horace Judd presented a paper describing and giving the results of their experiments with 'Pitot Tubes,' and on 'The Experimental Determinations of the Forms of Water Jets.' The paper describes "a Pitot tube as a simple contrivance for measuring the velocity of water. It consists of a small tube placed in the stream so that the water strikes fairly against one end. Some distance from the end it is bent and connected to a vertical glass tube. The current striking against the end produces a pressure which is measured by the height to which water rises in the glass tube (or, in case of high pressures, by a gauge of some sort). Pitot claimed that this height was equal to the distance a body must fall to acquire a velocity equal to that of the stream. Later observers have thought that this is incorrect, and that the water rose much higher. These experiments were with jets, and showed that Pitot was practically correct. Incidentally it was found that the contracted vein in a jet of water from an orifice in a thin plate is about .785 of the diameter of the orifice, and that the velocity of such a jet is over 99 per cent.

of the theoretical velocity. The paper describes experiments to determine the constants of Pitot tubes. Tubes with variously formed tips and of inside diameters ranging from .162 inch to .007 inch were placed in the jet from an orifice in a thin plate. Each tube gave a pressure practically the same as that in the drum, from which the water was flowing. No change was observed when the tubes were moved back and forth along the axis of the jet, the increase of static pressure back of the plane of the orifice exactly compensating for the diminution of velocity pressure. To determine the velocity of the jet, measurements were taken of the coefficient of contraction, the coefficient of discharge, and of the relative velocities at different distances from the axis of the jet. The mean velocity from a two-inch orifice was found to differ from that in the center by less than .0002. The coefficients were:

| Orifice. | Coefficient of Contraction. | Coefficient of Discharge. | Coefficient of Velocity. |
|---|---|---|---|
| 2 inch. | .6162 | .6112 | .992 |
| 1.5 inch | .6115 | .6119 | 1.001 |

As the velocity was practically the same in all parts of a section, the figures for the coefficient of velocity represent the constants of the Pitot tubes, which give readings equal to the static pressure behind the orifices. Similar measurements were made with a short pipe from which the coefficient of the Pitot was found to be .993.'' The hydraulic micrometer caliper described in the preceding paper was used in making the above measurements.

Professor J. Burkitt Webb, of Stevens Institute, Hoboken, N. J., presented a paper on 'Molecular Velocities,' in which he offered a simple illustration in support of Maxwell's theory that the only permanent state for the molecules is one in which the velocities are not the same for all molecules, but that all possible velocities must be supposed arranged according to the law of probabilities. ''Suppose a number of small elastic spheres of equal mass moving in all directions with equal velocities, and consider two of them moving at right angles to each other, and so that sphere *B* strikes sphere *A* at the instant that the center of *A* crosses the path of *B*, the velocity of *A* in the direction of *B's* motion is zero, and therefore all of *B's* motion will be transferred to *A*. This will increase the velocity of *A* from $v$ to $v\sqrt{2}$ Evidently another rectangular blow from a sphere *C* would increase this velocity to $v\sqrt{3}$, and so on, so that we have in this a proof that an equal distribution of velocities would not be a permanent one, and that the final permanent distribution must depend upon the possibilities of the various phases of collision that may occur.''

Professor G. W. Bissell, of Iowa State College, Ames, Iowa, presented a paper on 'Iowa Coals.' He stated that the Iowa coal fields have an area of 20,000 square miles, and include the southwest one third of the state. The Des Moines valley mines are the most active. In this district coal is found at depths of from 100 to 300 feet in veins from 18 inches thick and upwards. The thinner veins are profitably worked in conjunction with the manufacture of brick and other clay products made from the coal shales. Iowa coals are mostly bituminous and non-coking. The average proximate analysis gives:

| | | |
|---|---|---|
| Moisture ................ | 8.08 | |
| Fixed carbon ............ | 45.60 | |
| Volatile ................. | 38.14 | |
| Ash .................... | 8.18 | 100.00 |
| Sulphur ................. | 3.42 | |

The calorific power of Iowa coals as determined at Iowa State College with the Parr calorimeter ranges from 9,180 to 13,141, with an average of 11,780 B. T. U. per pound of oven-dried coal. From a

number of proximate analyses of Iowa coals, and from determinations of their calorific value by means of the Parr calorimeter, he deduced the formula that the calorific value of an Iowa coal $= (14{,}600C + 12{,}180V + 4{,}000S) \times .01$ B. T. U. The following table gives the results of boiler tests made with Marquisville (Iowa) coals of different sizes, with coke and anthracite nut, and is of interest in showing the prohibitive price of anthracite, and that the fuel cost of generating steam with slack coal is from 30 to 40 per cent. less than the fuel cost with lump, nut or steam coal in the same mine.

| Kind of Fuel. | Cost per ton of 2,000 lbs. | Fuel cost of 1,000 lbs. steam from and at 212°. |
|---|---|---|
| Marquisville, Slack.... | $1.43 | 14.9 cents. |
| Steam.... | 2.35 | 21.2 " |
| Nut...... | 2.54 | 21.5 " |
| Lump.... | 2.88 | 24.0 " |
| Coke, Eastern Foundry. | 8.00 | 60.4 " |
| Anthracite Nut........ | 8.95 | 52.8 " |

Following in this line came a paper by Professor C. H. Benjamin, of the Case School of Applied Science, Cleveland, Ohio, on 'The Science of Smoke Prevention.' As Professor Benjamin was for several years the engineering expert in enforcing the ordinance against smoke production in Cleveland, his conclusions are the result of both scientific attainment and practical experience in dealing with the smoke question in cities. They are as follows: (1) That objectionable smoke from soft coal can readily be prevented; (2) that such prevention will result in a higher efficiency and smaller fuel bills; (3) that all new plants should be subject to permits issued by proper city officials; (4) that educational and legal measures combined should be used in cases where the evil already exists; (5) that the control of such work should be in the hands of properly trained engineers who understand the whole subject thoroughly; (6) that the people of each community must see to it that they are protected from this evil as from poor drainage and dirty streets.

Professor William T. Magruder, of Ohio State University, Columbus, Ohio, presented a paper entitled 'A Producer Horse Power—A Proposed New Unit.' After reviewing Watt's unit for a boiler horse power, and that adopted by the Philadelphia Centennial Commission, he stated that the rapid introduction of the use of gas-engines using blast-furnace gas or producer gas leads to the suggestion of a unit for the horse power of a gas producer similar to the unit for the horse power of a boiler. As some gas engines are now delivering a brake horse power for the generation of 10,000 B. T. U. per hour, and a few are doing 10 to 15 per cent. better than this, he suggested as a proposed new unit that of a 'producer horse power.' He defined it as 'the generation in an hour of sufficient gas at 60° F. to produce 10,000 B. T. U. when burned to water and gas at 60° F., or its equivalent.'

Before availing itself of the invitation of the St. Louis Engineers' Club, the section listened to a paper by Mr. A. P. Greensfelder, assistant engineer of the Terminal Railroad Association of St. Louis, on 'Recent Improvements at the Union Station at St. Louis.' The paper was illustrated by the plans for the improvements which are now under way, showed the necessity for them for handling the passenger and freight business of St. Louis, and described in some detail the methods which had been adopted for changing the tracks and moving all the express company buildings, while operating over 1,100 passenger cars each day. Incidentally, the paper showed the advances which have been made in terminal railroad facilities by the use of applied science.

AERONAUTICS.

The program for Wednesday morning was made up of a series of papers on problems connected with aeronautics. Professor J. Burkitt Webb, of Stevens Institute, Hoboken, N. J., presented two papers. One was on 'The Flying Machine Problem,' in which he showed among other things that 'for rapid flight a considerable altitude is favorable.' The second one was on 'Practical Artificial Flight.' The author stated that the inventor should aim for the most practical results and should attack the main difficulties at the start. To this end, he suggested that the question of motive power be eliminated, and that power be supplied from a trolley or from an overhead source, and that the endeavor should be to develop a machine which can slowly and surely rise from the ground and as slowly and safely descend again; and which should be controlled by an automatic balancing device.

Mr. A. Lawrence Rotch, director of the Blue Hill Meteorological Observatory, Hyde Park, Mass., read a most interesting paper, which was illustrated by the stereopticon, descriptive of the 'Exploration of the Atmosphere as Practised with Kites at the Blue Hill Observatory since 1894.' The methods employed and the results obtained are in part described in the appendix of the 'Smithsonian Report' of 1900, and the later technical details will be published in the *Annals of Harvard College Observatory*, Part III. of Volume XLIII.

'The Aeronautical Contests at the World's Fair, St. Louis, 1904,' were outlined and discussed in three papers presented by Professor Calvin M. Woodward, Washington University, St. Louis, Mo., Mr. A. Lawrence Rotch, director of Blue Hill Meteorological Observatory, Hyde Park, Mass., and Mr. Willard A. Smith, chief of the transportation exhibits, and in charge of the Department of Aeronautics, of the St. Louis World's Fair. All three gentlemen are members of the committee having the subject in charge. Professor Woodward introduced the subject. Mr. Rotch described and illustrated with the lantern the most successful dirigible balloons and flying machines, some of which are likely to be tried at St. Louis, and discussed the regulations for these experiments as drawn up by the committee. Mr. Smith continued the subject, discussing it in detail, and describing the facilities which would be offered to contestants for inflating their balloons with hydrogen gas, 97 per cent. pure, made by a new English process, which is guaranteed to deliver 25,000 cubic feet of hydrogen for the combustion of one ton of slack coal. The method of generation, it was stated, will consist of the dissociation of steam by incandescent iron shavings, and the revivification of the oxide of iron so formed by producer gas.

The last paper of the morning was by Mr. Octave Chanute, on 'Aerial Navigation,' and was a most able one. After calling attention to two probable solutions of the problem, he described what has been accomplished with balloons and flying machines, the evolution and limitations of such apparatus, their limited uses, and discussed the prospect of any one winning the prize offered by the World's Fair Commission. It is published in the March *Popular Science Monthly*. The series of papers being by noted specialists of high scientific attainments were greatly enjoyed by all those who availed themselves of the privilege of hearing them.

THE HYDROLOGY OF THE MISSISSIPPI RIVER.

The Wednesday evening program included in its scope the entire Mississippi River Valley, beginning with a paper by Professor C. W. Hall, of the University of Minnesota, at Minneapolis, Minn., on 'The Stream Flow of the Upper Mississippi

River' and ending with a paper by Mr. James A. Seddon, of St. Louis, on 'The Lower Mississippi River.'

Professor Hall's paper was illustrated by a number of lantern slides showing the head-waters of the Mississippi, the geological formations of the valley and a study of the currents and the flow of the waters of the river.

A paper by Judge R. S. Taylor, of Ft. Wayne, Ind., a member of the Mississippi River Commission, was then read on 'Levees, Outlets and Reservoirs.' He stated that the alluvial valley of the river below Cairo contains 29,790 square miles of lands subject to overflow in its natural state; that it is all capable of protection and reclamation by levees, which has been going on for nearly 200 years, except a small area at the foot of each drainage basin, which has to be left open for the escape of surface drainage. The existing lines of levees are about 1,350 miles long and about 80 miles remain to be constructed to complete in length the main river system. In few places, however, are the embankments as high and as strong as they should be for the greatest safety. 'The potential high water of floods to come' has been the subject of much study and discussion. The nearest approach to a standard has been that the levee should be three feet above the highest previous flood line in that locality.

The flood of 1897 made 38 crevasses having an aggregate width of about 8 miles; the flood of 1903 made 9 crevasses, having an aggregate width of about 3 miles. The levees in place in 1903, if no crevasses had breached them, would have protected about 26,000 square miles from overflow. Of that area a total of about 3,000 square miles was overflowed in consequence of the crevasses which took place, which is less than one eighth of the entire area which the existing levees could and would have protected if they had all been high enough and had held their places. In the phrase of the target-shooters, they accomplished 87½ per cent. of success out of a possible 100. The levee system is at this moment in the very crisis of its history. It has demonstrated the possibility of its usefulness. It wants just the last grand effort to carry it to completion. We ought not to think of the diversion of any part of our resources to any other work while that remains unfinished. During the flood of 1903 the existing levees protected from overflow seven eighths of all the lands capable of protection. If great floods should come once in five years, and we should never do any better than we did last spring, this would mean that there would be an average annual inundation of 2½ acres out of every 100 acres. This would seem to show that the present system of levees is successful. The author does not believe in the successful protection by outlets and reservoirs, and paid their advocates the compliment of a polite refutation of their arguments. The paper will be published by the Werner Co., Akron, Ohio.

He was followed by Professor Lewis M. Haupt, of Philadelphia, Pa., who referred to the law of 1879 and to reports of the 'Board of Engineers.' He quoted the resolution of congress of 1891 that 'no portion of the appropriation then made should be expended to repair or build levees for the purpose of reclaiming land, but only when it may afford ease and safety to the navigation and commerce of the river and deepen the channel. He stated that it was shown, by a comparison of surveys made at an interval of twelve years, that the bed had risen about four feet, and that the banks above low water had caved in to a large extent. He urged that the law be amended so as to provide for specific appropriations for levees to protect the waste and swamp lands, which, he claimed, were quite as de-

serving of national aid as the arid lands of the plains. He advocated a more thorough system of drainage by the removal of the obstacles and bars in the section below Red River. He discussed the statements made as to the effect of crevasses, showing from surveys that they are of great benefit in reducing the flood stages and improving navigation, as well as in adding extensive tracts to the arable lands of the state and nation. By removing a large percentage of silt from the river, they also retard the gulfward movement of the bars and flatter slopes which contribute to flood heights. By the natural process of hydraulic grading not less than 150 square miles have been deposited above the gulf level within thirty years. To have filled this up by dredges at ten cents per yard would have cost $1,500 per acre, which would have been prohibitory. He also dwelt on the need of removing bars from the front of all passes, by a curved form of jetty, simulating and applying the action of all streams in creating the deep-water pools found in their concave bends. Thus vessels could freely navigate all the passes, while at the same time the floods would be lowered and the sediment be deposited on the opposite or convex bank.

Colonel J. A. Ockerson, of St. Louis, with the aid of stereopticon illustrations described the work of the Mississippi River Commission, of which he is a member. He discussed some of the physical characteristics of the river and the subjects of flood control and channel improvement, and showed scenes along the river from its source to its mouth, including the levees and levee building, crevasses, and the hydraulic dredges used in the channels and the methods of removing obstructions to navigation.

The last paper of the evening was on 'The Lower Mississippi River,' by Mr. James A. Seddon, of St. Louis, Mo. He stated that the word 'river' is a geographical and not a physical term. That, unlike the tidal rivers, the Mississippi is a power that has made its valley and is master of it. The great flood has more than ten times the power of Niagara in its flow to the gulf. He discussed in considerable detail the physical conformation of the valley, showed that the river has an excess of power to carry its sediment, and stated that the only place where the Mississippi River has formed a bar by dropping this sediment is where it meets the waters of the gulf. At the mouth the flow can no longer carry its sediment, as it is too weak. In the valley the flow is too strong and it chokes itself up and spreads out in shallows. He discussed the subject of dykes and bank protection and gave many interesting facts concerning levee history. The author is in favor of a reservoir system of protection, and stated that this would give the bottom lands a certain flood protection, while emptying the reservoirs at the time of low water in the river would triple its depth, and the cost of the work of reservoir construction would have been a little more than half of the $80,000,000 which has been spent on the lower Mississippi. By this means the river would become a deep waterway which would not stop at the Ohio River, but continuing up the Illinois River through the Chicago drainage canal, would join the lake and gulf commerce. He is of the opinion that what is most needed in this case is a statesman to see 'that the river and harbor bill carries a responsibility that will produce results with its expenditure.'

This series of papers gave as complete a résumé of the subject as the time allotted would permit, and showed what a wide diversity of opinion there is among scientific experts on this extremely important problem in civil engineering and hydraulics.

The Thursday morning program was, as

usual, well filled with several papers which had been left over from Tuesday, and with the remaining papers of the program. One of these was by Professor Frank B. Williams, of Union College, Schenectady, N. Y., on 'Methods of Determining the Coefficients of Elasticity.' By loading a beam supported at its ends at two points equidistant from each other and from the ends, and thereby eliminating the cross shear, the coefficient of linear elasticity can be determined by measuring the deflections. Knowing $E$, the coefficient of elasticity for shearing is obtained by the formula given by Professor Merriman.

General E. W. Serrell, of West New Brighton, N. Y., followed with a paper on 'A Proposed Method of Building the Mandingo Ship Tunnel,' through the Cordillerian range of mountains in Central America, where the distance from sea to sea is but twenty-nine and one half miles. The Gulf of San Blas and the magnificent harbor of Mandingo are at the north end, while directly south, behind the Pearl Islands, within the Bay of Panama, is another harbor. The mountain range averages about 1,520 feet high. The proposed ship tunnel is to have portals 300 feet high. The length of the crown of the tunnel will be less than five miles. Instead of the shales found in the lines of the two other proposed routes for ship canals across the isthmus, the geological formation at this point has been investigated by an expert geologist, who states that the rock extends across the isthmus, that it is very uniform, strong and in every way suited for tunneling. Tested at the Watertown Arsenal, it was found to be stronger than Quincy granite. Analyzed at the geological laboratory at Washington, it was found that hornblende predominated in the granite. The canal-tunnel will be a straight line from sea to sea, and therefore capable of passing a ship of any length. The paper discussed the elements of the cross-section of the tunnel, the method for its construction, using three headings and understoped as well as open benches, and nine overhead tracks to remove the debris, and it is stated that the 18,000,000 cubic yards in the tunnel and the 37,000,000 cubic yards of excavation outside the tunnel can all be made for less than $100,000,000. It is estimated that the work can be completed in two years, although three years have been allowed.

Considering its good geological position, the excellence of the harbors available, the abundant supply of water at sea-level, no locks to delay passage of shipping, and more than ten times the capacity for business, as compared with any other proposed isthmian canal, it would be cheap at three or four times the cost, to say nothing of the short time which will be required to build it.

Before adjourning on Thursday to enjoy the hospitality of the officers of the World's Fair, the section had the privilege of listening to Lieutenant G. L. Carden, U. S. Revenue Cutter Service, on 'Some Topics Connected with the Machinery Department of the World's Fair.' The author is superintendent of 'arsenal tools' in the department of machinery at the fair, and was sent abroad and secured many of the foreign exhibits of machinery.

The section chose Professor David S. Jacobus, of Stevens Institute, Hoboken, N. J., as its vice-president for the next meeting; and, on nomination to the general committee, he was duly elected.

To say the least, the program of Section D was very full. A large number of the papers were by the leading experts of the country on the subjects discussed. It is questionable whether the interests of science are the better advanced by permitting a more lengthy and general discussion of the papers presented, than by having the

other sides of the same subject formally presented by some one who may not fully agree with the preceding author, but who has had time to prepare a written paper defending his position and advocating his opinions. While persons may differ in their opinions as to which is the better plan, the consensus of opinion of the members present was that the program presented gave them much information and food for thought. Many branches of mechanical science and engineering were touched upon, and while special emphasis was put upon those sessions devoted to aeronautics and hydrology, it was thought that the place and its surroundings warranted it.

The attendance at the meetings of the section has been excelled in recent years only by the 1902–3 Washington meeting. It is thought that this is encouraging for the future of the section. It is to be hoped that the members of the association connected with the section will show their continued interest in it by their attendance and by presenting papers at future meetings.

WM. T. MAGRUDER,
*Secretary.*

## *A REPLY TO RECENT STRICTURES ON AMERICAN BIOLOGISTS.**

A NOT uncommon, though possibly more or less indefinitely formulated, opinion has recently found an expression in print† to the effect that American systematic zoology has degenerated into a mere recording of minute facts, instead of being a study of problems; in other words, that it has been reduced to a somewhat low-level, though possibly sometimes useful, craft, and has lost caste among the sciences.

It must be admitted at the outset that this criticism is deserved to a limited extent. If we take ornithology as an example, what are the results of our labors in this country? Look over the long files of the *Auk* and see what they contain: An astounding and in many ways admirable record of facts relating to the distribution of our birds, their habits, their specific and subspecific characters! The refinement and acumen of discrimination with regard to the latter have reached a high degree of development, and it is doubtless true that the birds of North America are better known than those of any other part of the globe of even approximately similar extent. Our collections of native species are vastly larger and more complete than those of any other country and our methods and technique, both of collecting and of recording, greatly superior to those of the rest of the world. And the work goes on unceasingly, and the details are being more skilfully and accurately and voluminously elaborated every day. In fact, we are working so fast and so well that we have left the rest of the ornithological world far behind. Some of the younger European ornithologists are trying to catch up, but they will never be able to do so because the North American material can only be had here and because we have gained such a lead in the race.

But for what purpose are we accumulating all this minute detail, this enormous material? What are we straining our best faculties, our acknowledged ingeniousness, for? Thus far we have but little to show that would give a satisfying answer to these questions. On the surface, at least, it looks as if we were following these pursuits chiefly for their own sake, for the satisfaction of mere accumulating, for the exercise of these mental faculties. To the outsider it must certainly appear as if we regard the work we are doing as an end, not as a means towards an end. The ques-

* Read at the Twenty-first Congress of the American Ornithologists' Union, at its meeting in Philadelphia, November 18, 1903.

† Talcott Williams, 'On the Skirmish Line of Science,' *Booklover's Magazine*, II., November, 1903, p. 458.

tion then arises: Have we really, in our eager pursuit of the details, lost sight of the final object of our studies, which alone can justify the expenditure of brain work and money; and have we thus degraded our science to a mere sport or a brilliant juggling with facts and words? Have we forgotten that the problems are the essential part of science and that the records are only the tools with which to work out the problems?

Thus far there are but slight indications on the surface that the higher problems have attracted much attention, and I am afraid that many of us must plead guilty to having groped in the lower regions so long that we almost forgot that there is something higher. Nevertheless, any one who has the opportunity to look below the surface must be aware that a notable amount of thinking and theorizing is going on without causing much outward commotion. While this holds true to a slight extent for the whole range of problems, it is particularly so with regard to a certain limited class, referring, as I do, to the problems more or less intimately connected with the question of life zones or the zonal distribution of life. Here, thanks to the brilliant work of some of the most prominent scientists of the American Ornithologists' Union, considerable progress has been made in the right direction, and more may be confidently expected in the near future.

It is not difficult to demonstrate just why this class of problems should first receive attention. The explanation is that not only have the requisite facts been recorded on an unprecedented scale and with a clear understanding of the requirements of the case, but nearly all the material necessary for at least a partial solution of the problems are available within the boundaries of this country. The question, up to a certain point at least, is a local one, viz., the interrelation between the North American biota and the various zonal areas which its component animals and plants occupy. Up to this point our scientists will be able to solve the problems. It must be conceded, furthermore, that the truly monumental way in which the material is being gathered, recorded and elaborated makes it possible for them to construct upon it a philosophic building which shall be more enduring than the ephemeral structures of past times. We may confidently look forward to the establishing of proof where formerly we had only uncertain theories and hypotheses.

Just here we have reached the point where we become aware of our limitations and their cause. We have the means of approaching and solving the local problems and questions in so far as they can be elucidated by local work, but we are utterly shut out from attacking the larger, more universal problems, without which we shall have to submit to the stigma of being mere *sciolists,* a name applied the other day to American biologists generally by a reviewer of the achievements of American science.

Whether we accept a holarctic region, or recognize the nearctic and the palearctic as two separate regions, no one will now deny that a great portion of the biota of the northern parts of the new and the old world is intimately related. But when it comes to the questions as to the extent and the degree of this intimacy; whether their faunas and floras have a common origin; or whether they are a blending of two or more biotas, and in such a case, where each component part originated and how the blending took place, by what routes and at what time—when it comes to these and similar questions, we find that opinions and theories are digressing in all directions. If we ask ourselves, in what genetic relation do the animals and plants now inhabiting the northern world stand to those living before them in the same territory; whether

the forms which to-day occupy a certain region are descended directly from those whose bones we find in the strata underneath them, or have originated in some far distant continent from ancestors indigenous there, we meet again a distressing amount of uncertainty and diversity of opinion. And if we inquire into the reason for all this controversy, this lack of agreement among biologists, one cause stands pre-eminently forth as responsible, viz., *insufficient and defective records!*

Thirty or forty years ago the biologists, with an almost childish faith, believed that they had gathered all the material that was to be had, and that they would exhaust the supply of facts in a very few years. Europe, according to them, was thoroughly explored, the records were complete; northern Asia had just been covered by the magnificent expeditions of Middendorff, Schrenck, Radde and others; the biotic secrets of North America were divulged in the Pacific Railroad reports, the Mexican Boundary reports, the reports of the expedition west of the 100th meridian, and of the survey of the territories. They conceded that a few more species might be expected to turn up in the interior of Africa, but these, it was thought, would not be able to alter conclusions materially. And so they proceeded to speculate and generalize, to pull biology out of the mire of mere recording and gathering of facts into the regions of real science. But unfortunately, although theories and hypotheses multiplied, they nearly all led in different directions, and each philosopher came to results at variance with those of the others, according to the kind of material or the portion of the record he happened to get hold of.

Far be it from me to speak lightly either of the records and material gathered by the men of that generation, or of their generalizations. It was not their fault if the ultimate results have been disappointing. Many of their records are of permanent value; a great deal of their material still serves as foundation for our present work; some of their conclusions and theories have proven to be correct. Without them we were not standing where we are now. The fault lies with their successors who considered the preliminary work finished and who failed to continue it systematically and symmetrically.

Shortly after the period alluded to it became painfully clear to biologists that the amount of facts, material and records which had been gathered was not only a mere handful as to numbers, but even more hopelessly defective as to accuracy and minuteness of the data. With the opening up of the world by means of improved facilities of communication, the enormous mass of new material representing unexpected forms in endless number fairly swamped the systematic biologist during his work of recording and describing. This flood of new species and genera naturally affected the scientists of Europe most, as it accumulated in the museums of countries which not only previously had colonial possessions all over the world, but now by the division of Africa despoiled a whole big continent of its most striking novelties. The American biologists, on the other hand, whose field was in nearly all cases limited by the political boundaries of the United States, were shut out from the rest of the world and reduced to a more intensive cultivation of their own area. The result has been curious in more than one way. On the one hand, our development became defective, because we lost touch with the outer world and so in a measure were left behind; while, on the other hand, we extended the accurate, *i. e.,* scientific, knowledge of our own field far beyond that of the rest of the world.

This, then, is the standpoint we occupy

to-day: We are still confronted by the same problems which our predecessors failed to solve because of their lack of definite and detailed knowledge of the facts. With a view to their solution we have gathered a material which, for technical perfection and minute accuracy, is unrivaled. It has but one fault—it is terribly lopsided. We have or are in a fair way of obtaining shortly most of the data relating to the nearctic region, but we have not a scrap of the right kind of material relating to the other half of the northern world. Nor is the right kind of material in existence anywhere at present; for while there is preserved in the numerous museums of Europe a large number of specimens, and while the literature contains a vast accumulation of records, neither the data accompanying the former nor the observations contained in the latter are, as a rule, so precise or so detailed as now required. This widely scattered material, in addition to its insufficiency due to superficial and haphazard collecting, is distressingly uneven in quality. Moreover, it has not been worked up according to uniform methods, nor by workers occupying the same viewpoint. Its component parts are not only uncorrelated, but they are at present utterly impossible of correlation.

Thanks to the example set here, Europe is just beginning to realize the fact that she has neglected her own fauna. Some of her more wide-awake biologists have recently attempted to grapple with the problems I have alluded to above, but they have not advanced much farther than to formulate them. They have found their *records far too insufficient and defective.*

Lest I be accused of exaggerating let me quote what I wrote more than two years ago in a review of the attempt, by a prominent European biologist, to generalize from the incomplete data at hand. After having said that one of the distinct merits of his work was that it revealed the defects in our knowledge, I continued:

"It is a kind of stock-taking by which we find out just how our business stands. It must then be admitted with regret that the status is not as satisfactory as one might have reason to expect. There is yet a great uncertainty as to the exact and detailed distribution of many of the larger and more important animals in the Arctic regions and in Europe. The grosser facts are known of course in a general way, but they are not sufficient for the purpose. The finer details are still unknown, or if known in some isolated cases are unavailing because they are as yet only isolated."*

This statement has remained unchallenged ever since and but little has been done to remedy the defects in a comprehensive way. What is true of Europe is no less true of Asia. Let me recall to you that a distinguished member of this union, in a paper published during the present year and dealing with a single class of vertebrates only, found himself obliged to bewail his impotency to settle important questions by such statements as these:

"Material from northern Europe available for comparison with the Siberian series is too scanty * * * to be of any importance. * * * "

"Also material is lacking in sufficient quantity to give much new information in respect to the supposed difference. * * * "

"But lack of material prevents a critical consideration of the subject. * * * "

"Without other material it is impossible to compare the present series. * * * "

"In the absence of specimens * * * it is provisionally referred. * * * "

And so forth no less than eight times in the same paper under eight different

* Scharff's 'History of the European Fauna,' *Amer. Naturalist*, XXXV., 1901, p. 113.

species.* I may add that he had the contents of all the leading museums of our country at his disposal.

Another member of the union, who also brought together all the available material from the American museums, published a monograph of a holarctic genus of birds last year.† He recognized 35 different forms by name, 22 from the nearctic region and 13 from the palearctic region. As a basis for this work he had no less than 2,150 specimens, a material which, if it had represented evenly the range of the genus, might have been sufficient to give an exhaustive account of the various forms and might have led to valuable generalizations with regard to their origin and their distributional migrations, but the ridiculous inadequacy of the palearctic material for the purpose may be plainly seen when I state that while the American specimens at his command numbered 2,108 specimens, or an average of over 95 specimens per recognized form, the European and Asiatic material consisted of 42 specimens, or $3\frac{1}{4}$ specimens per recognized form. Of three of the latter there is not a single specimen in any American museum.

One more striking example, this time derived from the class of mammals. The only museum in North America which has made strenuous efforts to obtain palearctic mammals, and which by all odds contains the largest material from the holarctic region, possesses about 94,000 specimens from the nearctic, as against about 3,300 from the entire palearctic. It is safe to say that this enormous discrepancy is even excelled in the other museums. A similar census of the birds in the same museum was not practicable, but it is perfectly safe to say that the proportions are nearly the same, or thirty nearctic specimens to each palearctic. The discrepancy is the more marked when we consider that the area comprised in the palearctic region is nearly twice as large as that of the nearctic, so that area for area the palearctic material in our museums is scarcely one and two thirds per cent. of the total holarctic material.

It is unfair, therefore, to blame the modern American biologist for his failure to enter a higher philosophic sphere. He has the ambition to do so, he has also the ability; moreover, he has done part of the preliminary work and done it exceedingly well. But as yet he is without the means.

And now, how can this unfortunate condition be remedied?

There is only one way, viz., *the acquisition of more and better palearctic material and records,* collected by professionally trained observers; worked up together with and conformably with the nearctic material and records already gathered and elaborated with such signal success. Because of the possession of the latter it follows of necessity that the American biologist should also gather and elaborate the former. The work already done preeminently qualifies him to carry the whole to a satisfactory conclusion. He has done the first part well; he will do the remaining work equally well, if only given the chance.

It may seem strange to call for more material and more records in reply to the accusation that we are losing ourselves in that very kind of work. It must be borne in mind, however, that what is here called for is not the insatiate, indiscriminate accumulation with no clear purpose in view, but a well-digested, premeditated search for the material which bears directly on the problems already outlined and which experience has shown to be indispensable for their solution.

The fact is that we are not losing our-

* J. A. Allen, *Bull. Amer. Mus. Nat. Hist.,* XIX., 1903, pp. 126, 129, etc.

† H. C. Oberholser, *Proc. U. S. Nat. Mus.,* XXIV., No 1271, 1902, pp. 801–884.

selves as alleged; it only appears so to the outsider. Yet, it is necessary that our higher duties should be held up to view 'lest we forget.' Moreover, the time has come for the gathering of the new material unless we are to sink back into a shallow rumination of the old. The American biologist stands ready to expand his dominion into the old world, if he be given the means, and when he shall be through with his work, the facts and records will be in such a shape that the philosopher can rear a structure upon them that will stand.

The means by which he may be put in this enviable position have been set forth in another connection* and need not occupy us here. LEONHARD STEJNEGER.

WASHINGTON, D. C.,
November 14, 1903.

* *Carnegie Inst. Yearbook*, No. 1, pp. 241–266, 'Plan for a Biological Survey of the Palearctic Region,' by Leonhard Stejneger and Gerrit S. Miller, Jr.

## SCIENTIFIC BOOKS.

*The Positive Philosophy of Auguste Comte.* By L. LÉVY-BRUHL. Authorized translation, to which is prefixed an introduction by FREDERIC HARRISON. New York, G. P. Putnam's Sons. 1903. Pp. xiv + 363. 8°.

Anything that will help to make the philosophy of Auguste Comte known to the readers of English can not fail to be useful. The English translation, therefore, of a work on that subject by such a man as M. Lévy-Bruhl, the well-known author of the 'History of Modern Philosophy in France,' and who 'writes as a student and not an adherent of Comte,' is especially welcome.

It will probably be one day regarded as the most remarkable anomaly in the history of science that the work which formed the turning point from metaphysical to scientific philosophy—the 'Positive Philosophy' of Auguste Comte—remained three quarters of a century without being translated into the English language. This singular circumstance has led to some very peculiar results, and accounts for the totally false idea that the English-speaking world entertains with regard to Comte and his doctrines. Many suppose that he was a very bad, irreligious man. An eminent divine recently stated from the pulpit that 'Comte, the great French philosopher, taught that religion was only a phase of superstition that belonged to the childhood of the race and would be outgrown.' Interrogated as to where Comte taught this doctrine, he was unable to cite any work or passage. The fact is that Comte had a strong religious nature, and one of his aphorisms was that 'man is becoming more and more religious.'

Others, like Huxley (who does not seem to have read the 'Positive Philosophy'), see nothing of value in Comte's system. A common opinion is that it is a sort of utopia, and Comte's name is frequently associated with that of Fourier. Scarcely any one has the idea that he was a scientific man in the accepted sense of the expression, although he was by profession a mathematician.

The fact that Comte wrote another and later work, his 'Politique Positive,' in which he drew up a program of social regeneration and founded a cult, created the general impression that he was only a dreamer. His zealous followers from the standpoint of the cult saw to it that this work should be translated into English. There is no doubt that this did incalculable harm to Comte's entire system. For, in the first place, as M. Lévy-Bruhl clearly shows, it is impossible to understand the 'Politique Positive' without an acquaintance with the 'Philosophie Positive.' If Lévy-Bruhl had done nothing else than to dispel the illusion that the 'Politique Positive' was an after-thought, the product of a diseased mind, and a mere dream of a fanatic, it would have fully justified his writing this book. The few who have read the 'Philosophie Positive,' and especially those who have also read the five early papers written from 1819 to 1825, know already that the 'Politique Positive' was contemplated by Comte from the beginning, and was steadily kept in mind during all the patient years that it required to write the 'Philosophie Positive.' That work was to be simply the necessary preparation and scientific foundation for his final great con-

struction. How many edifices have crumbled whose foundations have stood the test of time! But the superstructure was built upon that foundation, and every line of the 'Politique Positive' must be read with the 'Philosophie Positive' in full view, otherwise it is utterly incomprehensible. It is small wonder, therefore, that the readers of the English translation of the former, called Comte's 'Positive Polity,' could make nothing of it, and set Comte down as a dreamer or something worse.

Another marked consequence of the failure to translate the 'Philosophie' has naturally been a systematic plagiarism of Comte's ideas. Persons of a certain type, and they are common enough, finding a great body of original ideas in a work almost completely unknown, have made it their opportunity to pass themselves off as profound thinkers. A learned professor in one of the leading universities once came by invitation and read a paper on the classification of the sciences before one of the scientific societies of Washington. It proved to be simply a summary of the Comtian hierarchy, but Comte's name was not mentioned and the views were put forth as original with the speaker. There was only one member present who detected the plagiarism and felt it his duty to expose it. I have collected a large number of similar cases, many of which are amusing.

As a third effect of the same cause may be mentioned the manner in which Comte's ideas have influenced English thought. Accessible only to the highest types of mind, they found themselves reflected only from such high sources, and as such men usually have systems of their own, they strive to conceal the extent to which they are influenced by others. This has been notably the case with Comte's influence. In this day it is easy to see that it was very great in England. John Stuart Mill and George Henry Lewes were the most frank in acknowledging it, but it is now clear that Carlyle, Buckle and many others were profoundly affected. That Herbert Spencer recognized Comte's value to the scientific world no one now doubts, notwithstanding his vigorous disclaimers of discipleship. No one has maintained that he was a disciple. Indeed, the only disciples were those who accepted and strove to propagate his religion of humanity, and these usually cared very little for his scientific works; otherwise they would have had his 'Philosophie Positive' translated. That Spencer arranged his topics in substantially the Comtian order I have repeatedly shown,* but this does not imply discipleship, since it is the true order of nature. But Spencer could not have been ignorant of Comte's classification of the sciences. It had been before the world for thirty years before Spencer began the 'Synthetic Philosophy.' Others besides Mill had expounded it, and it was familiar to all the best minds. Spencer adopted both of Comte's new words 'sociology' and 'altruism,' and defended them with proper acknowledgments. Even his 'Social Statics' proved to be Comte's term, although Spencer thought it was Mill's. But his book by that name shows that he really had no idea of Comte's social statics or of social statics in any scientific sense.

Notwithstanding the handicap of a foreign language, Comte's fundamental doctrines have conquered the scientific mind, not only of England, but of the whole world. In conformity with the Scriptural saying, France was the last to recognize its own philosopher, but his day is now come. Streets are named for him, statues are erected to him, and his power has penetrated not only into academic but into legislative and administrative halls.

M. Lévy-Bruhl passes Comte's entire philosophy in review, but the treatment is somewhat uneven. The biological side is the least complete. It is true that Comte was not strong in biology, and accepted with certain reserves the doctrine of the fixity of species, as did nearly everybody in those pre-Darwinian days, but he was acquainted with Lamarck and believed in evolution and in the descent of man from an animal, even simian, ancestry. He worked out the doctrine of the interaction of the organism and the environment and carried it to a very advanced stage. He even foreshadowed the principle of natural selection, and it is remarkable that Lévy-Bruhl

* See SCIENCE, N. S. Vol. III., February 21, 1896, p. 294; 'Pure Sociology,' p. 69.

failed to point this out, especially as it had been pointed out by others, first in 1883 by the writer of this review,* and subsequently by Heinrich Waentig,† and also by his own countryman, M. Alfred Fouillée,‡ the passage being quoted in each case. It will bear quoting again. In the third volume of the 'Philosophie Positive,' which appeared in 1838, written, as he states in 1836, on page 392 he says:

> If we conceive all possible organisms to be successively placed, during a suitable time, in all imaginable mediums, the greater part of these organisms would of necessity finally disappear and leave only those surviving which could satisfy the general laws of this fundamental equilibrium; it is probable that, after a succession of analogous eliminations, the biological harmony must have established itself little by little upon our planet, where we still see it continually modifying itself in a similar manner.

A scarcely less remarkable passage occurs in the fourth volume (p. 443), which appeared in 1839.

Lévy-Bruhl's treatment of Comte's psychology is much more satisfactory. It may seem strange that he should devote a chapter to psychology, when Comte expressly repudiated the word. But he gives a simple explanation of all this. In Comte's day psychology meant 'the science of the soul reached through the introspective method.' 'It was the science founded by Cousin on the analysis of the ego,' as taught by the eclectic school of philosophers. "Comte, who opposes these philosophers, did not wish his theory of psychical phenomena, which differed from theirs, to be called by the same name." He said in 1828: "Some men, not recognizing the present and irrevocable direction of the human mind, have endeavored for ten years to transplant German metaphysics into our midst, and to constitute, under the name of *psychology,* a so-called science entirely independent of physiology." Comte refused to regard psychic phenomena as distinct from those of physiology, and, therefore, he included their study in biology, although he spoke of them as dealing with 'transcendental functions.' In fact, Comte thought that there might be a true science of *phrenology,* and tried to found that science, although, even in his day, as he himself knew and deplored, the process of prostituting that term had already begun, and soon after his death this had gone so far that the word, notwithstanding its perfect etymology and appropriateness, was wholly abandoned by scientific men, and the term psychology was resuscitated and adopted for the same science. But it is absurd to accuse Comte, as has been done, of lending any countenance to the vagaries of phrenology.

M. Lévy-Bruhl brings into clear relief the importance of sociology as a necessary part of Comte's scheme. When we remember that down to the year 1839 he had always called this science 'social physics,' first using this term in 1822, we can see very clearly what was in his mind. With him the characteristic of a true science was that its phenomena should conform to invariable laws. This he believed social phenomena to do. The name social physics was chosen to emphasize this view. It completed the series and supplied the final term that had always been lacking. 'We possess now,' he said, still at that early date, 'a celestial physics, a terrestrial physics, either mechanical or chemical, a vegetal physics and an animal physics; we still want one other and last one, social physics, in order that the system of knowledge of nature be complete.'

But he went farther and divided up the science on strict mechanical lines, founding both social statics and social dynamics. It would unduly extend this review to attempt to show how these two sciences were constituted, and the reader is referred to Lévy-Bruhl's fairly satisfactory presentation of the subject. But any mention of Comte's name almost requires the coupling of it with some reference to his celebrated law of the three stages (*trois états*) in the historical development of human thought, which constitutes the basis of his social dynamics. The attempt to maintain that this law was discovered and announced by Turgot, Condorcet, Burdin and

* 'Dynamic Sociology,' Vol. I., p. 119.

† 'Auguste Comte und seine Bedeutung für die Entwicklung der Socialwissenschaft,' Leipzig, 1894, p. 120.

‡ 'Le Mouvement Positiviste et la Conception Sociologique du Monde,' Paris, 1896, p. 101.

others is like ascribing the discovery of the principle of natural selection to Goethe, or Wells, or even to Comte himself, merely because in the writings of all these are to be found adumbrations of it. Comte it was who formulated the law and developed it at full length, devoting more than two volumes of the 'Positive Philosophy' to its elucidation, 'in all of which,' said John Stuart Mill, 'there is scarcely a sentence that does not add an idea.' Suffice it to say that it is a historical demonstration of the aphorism that ideas rule the world, and constitutes a complete philosophy of history based on the dictum of Leibnitz, that in all ages 'the present is full of the past and pregnant with the future.'

But this law has a still deeper significance, since whatever we may think of the theological and metaphysical stages of history, the positive stage is the age of scientific thought. The full characterization of this stage is the essence of the positive philosophy. As George Henry Lewes said, 'positive thinkers may be counted by thousands, but no one before Comte had a glimpse of the positive philosophy.' Now, to add sociology to the 'hierarchy' of the sciences was simply to complete the scheme of the 'Positive Philosophy.' Without it the scheme was truncated. But sociology was more than any of the other sciences. It was in a certain sense the science of the sciences, since it presupposed and embraced all the rest. An acquaintance with the others was necessary to it, because it was a synthesis of them all, and dealt besides with social phenomena, with which none of the others had anything to do.

So far as ethics is concerned, M. Lévy-Bruhl clearly shows that it is with Comte simply an aspect of sociology. Comte's ethics is not a moralizing, or a treatise on duty or on right and wrong, but a discussion of the origin of ethical ideas, growing out of the, as he claimed, spontaneous sociability of men—in a word, it is social ethics.

We need not follow our author farther and point out the 'positive transpositions,' or revaluations, that the positive philosophy has wrought in the ideas that prevailed before Comte's day. It is sufficient to have shown that M. Lévy-Bruhl has set him in a just light before the world as a great organizing genius. His knowledge relatively to the time he lived was, like that of Spencer for his time, encyclopedic. Different as the systems of these two philosophers are, they each have practically the same relation to their respective dates and times. Comte was the philosopher of the first half, as Spencer was of the second half, of the nineteenth century. Comte's weight turned the scale in favor of the scientific method, and inaugurated a positive, which is the same as a scientific, *Weltanschauung*, destined to banish the hitherto prevailing theological and metaphysical conceptions of the universe. As Comte's works are more fully studied it is found that they constitute a vast storehouse of ideas. When a supposed new thought is put forth by some modern writer nothing is more common than to find that Comte had given clear expression to it more than half a century earlier. Much of the contemporary sociology consists in the rediscovery of the truths that Comte reached and fully set forth, and sociologists are just beginning to learn that they must go back to Comte as certainly as the metaphysicians must go back to Kant.

M. Lévy-Bruhl, in citing Comte's 'Philosophie Positive,' has used the fifth edition, 1892, which, unfortunately, is not uniform with all previous editions, and this makes the verification of passages somewhat difficult for those who can only consult the earlier and better known editions. The English translation bears the marks of 'business enterprise.' The short note by Mr. Frederic Harrison is magnified on the title-page into an 'introduction.' It is matter for regret that Mr. Harrison did not really contribute an introduction. On the other hand, the name of the translator, Kathleen de Beaumont-Klein, who contributes an excellent preface, does not appear on the title-page.

The translation is in the main good, but it is easy to find what are called 'gallicisms,' such as using the word *ignore* in the French sense of not to know, writing *movement* for *motion*, *experience* for *experiment*, *precious* for *valuable*, *conscience* for *consciousness*, etc. There certainly was no excuse in an English

translation for citing all German works by their French titles. Lester F. Ward.

Washington, D. C.

*Light Waves and Their Uses.* By A. A. Michelson. Decennial Publications of the University of Chicago. Second Series, Volume III. University of Chicago Press, 1903.

The 'uses' with which this book is concerned are altogether those with which the author's name is so intimately associated; that is, the applications of interference methods whereby light waves are made the tools and units of measurements for physical and astronomical investigation. The Michelson form of interferometer, which has tremendously increased the applicability of this method, was invented as a means of attack upon one important problem which is here treated briefly —the well-known Michelson-Morley ether-drift experiment—still the subject of study, both experimental and theoretical.

An introductory chapter on wave motion and the general phenomena of interference serves to prepare the reader for the development of the interferometer principle, by which is meant the use of a plane reflecting and transmitting (glass) surface to split a beam of light into two, which are subsequently recombined, to produce interference fringes. The quantity directly measured is either a movement or shift of these fringes, or a change in their distinctness or 'visibility,' produced by changes in the relative retardation of the two beams between the points of separation and recombination. By this means changes in the relative retardation, which may in a particular case be produced by changes in position of a plane reflecting surface, can be measured with extreme accuracy. Again, the change in relative retardation may be produced by changes in the index of refraction of the medium through which one beam passes, or motion of the medium, or by the introduction of transparent films—and the corresponding shift of the fringes affords an exceedingly accurate means of measuring these changes.

Some of the many special cases in which this method has been applied are dealt with in succeeding chapters; for example, the measurement of angles and distances, the study of spectrum lines and close groups of lines, the effect of a magnetic field on light-emission, the determination of the angular magnitude and 'structure' of stars, and the fundamental, but less fascinating, matter of the use of light waves as standards of length—*i. e.*, the evaluation of the meter in terms of the wave-lengths of the red, green and blue radiations of cadmium.

The book is avowedly popular, being a reprint of Lowell Institute lectures, and the lecture style is retained throughout; nevertheless, it is to be feared that without the aid of experimental demonstrations, for which the good illustrations are hardly an equivalent, the 'general reader' would be rather overtaxed by some of the chapters. However, from the other standpoint of the preface, the book as a résumé in untechnical form, of important researches which have occupied Professor Michelson for the past twenty years, will be of great value, not only to scientists who have not read the original papers, but to many who have. C. E. M.

*Index to the Literature of the Spectroscope* (1887 to 1900, both inclusive). By Alfred Tuckerman. Smithsonian Miscellaneous Collections, 1902.

This index forms a continuation of a previous volume by the same author, which dealt with the literature up to 1887, and continues the subject up to the time when the work was taken over by the International Committee for Indexing Scientific Literature. The first half of the book is taken up with the author index, alphabetically arranged, of which the chief characteristics should be accuracy and completeness. Concerning the former a short examination suffices to detect a fairly large number of misprints, mostly trivial, besides a few cases of confusion of names, and one erroneous reference. Again, while absolute completeness is too much to ask for, there are omissions here which do not seem based on a fair estimate of the relative importance of various papers.

The second half of the volume contains the

same titles arranged according to subject, and here the matter of judicious choice of main and subheading, the distribution of titles among them, and cross-referencing, are of especial importance. In some cases, as, for instance, the heading 'Electric spectra,' too little subdivision has been made, while in others, for example, infra-red work, too many and not sufficiently distinct subheadings have been introduced. Cross-references and a list of the subdivisions of the subject index would be a great addition; and the more frequent insertion, as is done in some cases under 'absorption spectra,' of a few words of explanation as to the scope and character of the work would add greatly to the usefulness of this part of the volume.

In spite of these faults, however, and in spite of the fact that Kayser's 'Handbuch' will doubtless contain more references, this bibliography should be of considerable value.

C. E. M.

## SCIENTIFIC JOURNALS AND ARTICLES.

*The American Naturalist* for December, 1903, presents the third of the series of articles on 'Adaptations to Aquatic, Arboreal, Fossorial and Cursorial Habits in Mammals,' the present being by H. W. Shimer on 'Fossorial Adaptations.' These are fewer in number than those for other modes of life, but among them the writer fails to include the use of the tail as a tactile organ, making the mistake of supposing it to be 'a useless appendage.' W. Patten gives a valuable paper 'On the Structure of the Pteraspidæ and Cephalaspidæ' with the purpose of strengthening his theory on the genetic relationship between the vertebrata and arthropoda, and James G. Needham describes 'An Out-Door Equipment for College Work in Biology.' Unluckily, all colleges are not so well situated as that of Lake Forest. W. McM. Woodworth has a most interesting 'Preliminary Report on the Palvlo Worm of Samoa, *Eunice viridis* (Gray.)' W. E. Ritter gives 'Further Notes on the Habits of *Autodax lugubris*,' including the important information that this species breeds in holes in trees. The concluding paper, by Wilmatte P. Cockerell, describes 'A Trip to the Truchas Peaks, New Mexico.' The number contains the 'Quarterly Record of Gifts, Appointments, Retirements and Deaths.'

*The American Museum Journal* commences its fourth volume with the January number; it contains much information as to new exhibits, including notes on 'The Behavior of the Minerals and Gems of the Morgan Collections toward Radium and Other Sources of Light,' 'The Long-tailed Japanese Fowls,' 'The Draught Horse in Action,' 'Extraordinary Ants' and 'The Exhibit of Chuckchee Clothing.' The skeleton of the great Percheron, mounted by S. H. Chubb, is the best mounted skeleton we have ever seen and shows what may be done in this direction. The Supplement, Guide Leaflet No. 13, is an illustrated General Guide to the American Museum of Natural History.

## SOCIETIES AND ACADEMIES.

### ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE twenty-fifth annual meeting was held January 12. The following officers were elected:

*President*—Dr. D. S. Lamb.
*General Secretary*—Walter Hough.
*Curator*—Mrs. Marianna P. Seaman.
*Treasurer*—P. B. Pierce.
*Councilors*—Dr. George M. Kober, J. D. McGuire and Dr. J. Walter Fewkes.

The 254th meeting was held January 26. Dr. W J McGee reported progress of the various expeditions to secure examples of interesting tribes for the Louisiana Purchase Exposition. It is intended to have at St. Louis families of Central African pygmies, Tehuelches of Patagonia, and Ainos of Hokkaido, and members of tribes of the United States engaged in ancient industries. A model school for Indians will be another attractive feature.

The first paper was by Professor W. H. Holmes, the title, 'One of the Great Stone Buildings of Yucatan.' The paper was illustrated by a superb model made for exhibition at St. Louis. Professor Holmes said that the architecture of the natives of America is not

well understood, and the subject has received less attention than it deserves. There is, however, a widespread interest in the more noteworthy products of the skill of the aboriginal architect and builder, and for this reason five examples of the great buildings of Mexico have been selected and models prepared. The building described is the largest in Uxmal, and is 320 feet long, 40 wide and 20 high. The walls are of rubble cement and earth faced with limestone, the front wall 4 feet and the back wall 9 feet thick. The remarkable feature of this building is the cornice, of which there is 740 feet, with 10,000 stones set in it. Masks numbering 180, requiring 5,000 stones, meander over the cornice, and at intervals are placed seated figures bearing elaborate head dresses. The building was a residential one, and was the first of a projected group around a square. The paper was further illustrated with diagrams and detail models.

Professor L. S. Rowe, of the University of Pennsylvania, presented a brief communication, entitled 'The Work of the American Academy of Political and Social Science.' Professor Rowe said that there is serious danger that political science will become a mere dogma, and for this reason anthropology should come to its aid, mainly by defining the origin of social relations. To this end he bespoke the good offices of anthropologists in the field of political and social science.

Dr. McGee said, in discussing Professor Rowe's communication, that anthropology and political science are closely related, and that the appreciation of the aid of anthropology is gratifying. The most advanced views are upheld in the Anthropological Society of Washington. In this society there are sections each devoted to an aspect of the science of man. One is sociology, which embraces the relations of man as groups. Political science represents but one aspect of the same object that social science has to deal with. Political science has a narrower field, and deals with only one face of the great diamond.

Dr. Alës Hrdlicka read a paper entitled 'The Indians of Sonora, Mexico.' The paper was illustrated with lantern views of the people and scenery. Dr. Hrdlicka confined his remarks to the Yaki and Opata, giving a historic account and showing their geographical distribution. The Yaki are a virile tribe, and are not declining, while the Opata are being amalgamated. Dr. Hrdlicka gave an interesting account of these tribes, of which there is so little scientific observation. Numerous slides illustrated the paper which will appear in extenso in the forthcoming *American Anthropologist*.

Walter Hough,
*General Secretary.*

CLEMSON COLLEGE SCIENCE CLUB.

The club held its regular monthly meeting on December 18, 1903. Professor C. C. Newman gave a paper entitled 'Notes on Pecan Culture.' The speaker brought out the fact that the pecan grows wild over quite a large extent of territory in the United States. Methods of propagation were described, the fact being brought out that the usual method of planting seed for the production of seedlings is unsatisfactory, since these latter do not come true to seed. The high price at which the nuts are sold for seed was mentioned in passing. The only satisfactory method of propagation is by grafting. The speaker, by means of a number of specimens, illustrated in detail the different methods of grafting used. In closing, the possibilities of pecan culture on a commercial scale in the south and, especially South Carolina, were pointed out. Quite a large amount of interesting illustrative material was used by the speaker who gave this paper.

Professor J. Volney Lewis gave a paper entitled 'Notes on the Physiographic Development of the Rocky Mountains.' The author prefaced his paper with an outline of the leading events in the development of the Rocky Mountains in their relations to other portions of the continent. Some account was then given of observations made in the summit region of the Rockies between the North Platte valley in Wyoming and the canyon of the Arkansas in Colorado, in connection with the work of the U. S. Geological Survey in the Encampment region during the summer of 1902. The closely folded and faulted pre-

Cambrian rocks of the Encampment region, with east-west axes, were reduced to a peneplain at a time as yet undetermined, and the warping of this old surface by post-Mesozoic disturbances produced the arches of the present mountains, with their axes north and south. This peneplain is recognizable on the continental divide and the long spurs and parallel ranges to the east and west in the Encampment region. The sedimentary strata occupying the flanks of the mountains and valleys and 'parks' of this region doubtless once covered most, if not all, of the peneplain, but it has been laid bare over large areas of higher ground by subsequent denudation and more or less deeply incised by the streams. Brief reference was made to the dissection of the floors of some of the 'parks' by the streams draining them; to the systems of terraces occurring along nearly all the larger streams of the region and the diverse hypotheses accounting for their origin, and to the minor glacial phenomena. The paper was illustrated by a considerable number of lantern slides and maps.

F. S. Shiver,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### CONVOCATION WEEK.

To the Editor of Science: I heartily agree with the views expressed in your editorial of January 8 in regard to the affiliation of the various national scientific societies. If scientific men in this country are to exercise the influence they ought to exercise in educational matters; if they are to influence legislative action when it concerns scientific work; if they are to hold the place in the country which is due to them and their work, they must come together; they must learn to know each other and to act as a unit. It seems to me that it is very important to bring the scientific bodies together at least once a year. The American Association for the Advancement of Science has taken the initiative because it is the largest of all of the scientific societies. Its policy has been to hold a meeting during convocation week and invite the other scientific societies to meet at the same time and at the same place. The greatest freedom has been granted these bodies, and all the privileges which the large membership of the American Association for the Advancement of Science secures have been granted to them. There seems to be a feeling on the part of some of the societies, however, that the large association is trying to influence their action and force them into affiliation with it. I am confident that the only desire of the American Association is to bring the scientific men together for the good of all.

I would suggest that each national scientific society be asked to send a representative to a meeting to be held at some central point before next summer, where this whole question can be discussed in all of its bearings, and see whether it is not possible to arrange for meetings of all of the societies at the same time and place once each year or at other stated intervals. Such a committee could discuss the advantages and disadvantages of such gatherings, the influence which could be brought to bear upon scientific education and research and many other matters which would naturally suggest themselves. I believe that Science might take the initiative and request the various scientific societies to send representatives to such a meeting.

Charles S. Howe.
Case School of Applied Science.

As the editor of Science has pointed out, the advantages of the winter meetings of the American Association and of its affiliated societies are evident, and they certainly are desirable for those who can afford to attend them. The council, it is to be presumed, would be glad, however, to hear and to consider objections. Those of us who live on the Pacific slope have some that are peculiarly our own.

1. In order to attend a winter meeting we are obliged to rush off at the beginning of our very short Christmas vacation, and to spend a large part of that vacation crossing and recrossing the continent.

2. The trip is one of several thousand miles that requires from six to ten days on trains.

3. For this long trip we are unable to obtain

any considerable reduction of railway rates.

4. The season has certain objections for some of us who would like a few days of quiet with our families during the Christmas holidays.

The second and third objections may seem to hold also against the summer meetings of the association. But as the summer meetings fall in the long vacations a trip to the east is generally utilized for other purposes as well as for attending the scientific meetings, while the short Christmas vacation does not leave us time for anything else.

We of the Pacific slope, however, fully realize that this question should be settled with a view to the interests of the majority of the scientific men of the country, and that the majority lives east of the Rocky Mountains. We hope, though, that it will not be forgotten that the association has always tried to do a little missionary work whenever it has been possible. J. C. BRANNER.

TO THE EDITOR OF SCIENCE: Replying to your request for an expression of opinion relative to scientific organization in this country, I would say that the reorganization of the medical profession seems to me to offer an example which we might well follow.

Let the present American Association for the Advancement of Science be taken as basis, forming the national organization; let the present council be supplanted by a house of delegates, composed of representatives from each state society, the number being in proportion to the state membership; let all business affairs, questions of policy, etc., be transacted by this house of delegates; let the national association hold its meetings in convocation week, and be divided into as many sections as seems necessary or desirable for the purpose of presenting papers, but let it be divided into state associations for the purpose of representation and government. The national association can prepare a model constitution for the use of the state and local associations and have such constitution cast so that only the state or local names need be inserted, thus saving considerable expense, work and worry.

The state associations should hold independent meetings or two or three adjoining states could unite for joint meetings, preferably in summer. A division into sections could obtain for presentation of papers, but the business affairs could best be conducted by a state house of delegates, composed of delegates from the local associations. Such meetings would doubtless be attended by many college assistants, college students and especially high school teachers who can not afford to attend the national meeting and who might feel lost if they did attend.

Local associations could be formed in any community in which a given number of scientific workers could be organized. It is but natural that the universities and colleges would form the centers of the local societies and by interesting all senior students in the local societies, the national association would eventually practically represent a national alumni organization. At least all scientific students in colleges and universities would, upon graduation, enter the post-graduate national organization. In places like Boston, New York, Washington, Chicago, etc., there would be a differentiation into sections, according to subjects represented and members enrolled.

Such an organization would unite all American scientists into one strong body, which upon occasion would be an important factor in national or state legislative and other public matters. It would give every member of a local scientific society representation in the national organization. It would decrease expenses in local and state societies, and thus decrease the number and amount of annual dues, which are already too large. It might enable us gradually to assume control of and responsibility for technical publications. It might result in the union of several existing publications with the plan of distribution by signatures, so that it would be possible for a zoologist to subscribe for all of the zoological papers issued without his purchasing four times as many papers on other subjects, and the same advantage would accrue to the botanist, the chemist, the mathematician, etc. And to the great delight and relief of the bibliographer, such a plan would probably re-

sult in the early death and future prevention of the numerous struggling, ephemeral publications issued by various local organizations.

There is nothing original in the suggestions made above. The plan has been inaugurated by the medical fraternity and its good results are already evident. Would it not be wise for the scientific organizations to consider the same plan seriously, even if it should involve the demise of several existing organizations?

CH. WARDELL STILES.

WASHINGTON, D. C.

TO THE EDITOR OF SCIENCE: The problems connected with convocation week may be approached from the point of view either of that which is in the abstract most desirable or of that which is best adapted to present conditions. The latter question can not be treated properly without some consideration of the former, but it is idle to confine our attention to the ideal.

Few men of science can fail to recognize the enormous advantages resulting from the unification of all the scientific interests of the country under a single organization. The main question seems to be whether it is practicable to effect such a unification without the sacrifice of other and more important interests.

Objection is made on the part of the technical societies to any form of affiliation which would tend to degrade the professional standing of the membership of the societies. The objection certainly is a valid one, and reference to the editorial of January 8 will show that no such effect of affiliation on the professional societies is necessary or desired.

The objection to joint meetings growing out of the great extent of territory covered by the national organization and the resultant expense in time and money involved in reaching distant cities is common to any form of national society, however limited in scope, and may be met practically in a variety of ways. It certainly is not greater with the affiliated societies than with those entirely separate.

Another difficulty not so easily disposed of grows out of the crowding together of many programs in the short space of one week and the interruptions due to the numerous public lectures and social events of general interest. This situation presents a problem of the first magnitude and one better solved by a process of natural growth in experience than by academic discussion.

We have already had experience with three chief methods in the conduct of our mid-winter meetings. (1) Each society has met independently, with no attempt at correlation with any other organization. This was the method until very recently, with the result, perhaps, that three societies with which one might wish to keep in touch were meeting simultaneously in three widely separate cities, a situation so intolerable as to have provoked the agitation for convocation week.

(2) A second method is for the independent societies by mutual agreement to meet at one time in the same city. In the biological sciences we had a practical illustration of this at the last Washington meeting, where several sessions were held simultaneously offering programs covering substantially the same field. This situation was far from satisfactory to any of the membership, some declaring that it were better to return to the former plan of wholly separate meetings. Others considered that the resultant social advantages more than compensated for the distressing conflict of desires by which one was torn during the hours devoted to the reading of papers.

(3) The third method is for all of the societies to meet together and for those dealing with related subjects to combine their programs so as to have but one series of papers on the same subject running at one time. An inordinate length of program on any subject may be obviated by a further topical division of the program into smaller sections for all or part of the time. To be sure, it is a very difficult matter sometimes to find a natural line of cleavage in a program, but a separation of papers in accordance with any principle, however defective, is better than a separation based on no principle save the accidents of membership in the several societies; and if the programs are published in advance and are as closely followed as possible and espe-

cially if the paper in course of reading and the paper next to be read are posted outside each section room during the sessions, then it will be possible for any one at least to choose intelligently between papers appearing simultaneously, instead of leaving this largely to chance, as was too often the case at Washington.

That some such plan is not impracticable is shown by the very recent history at the St. Louis meetings, as illustrated by the program in zoology. Section F and the Central Branch of the American Society of Zoologists, by previous arrangement of their executive committees (these societies, by the way, not even being affiliated), combined for program purposes. This arrangement provided that all of the papers submitted and approved by the respective program committees should be considered by a joint program committee just before the meeting and that all papers approved by this joint committee should be pooled and arranged in a single program classified by subjects, with the proviso that if this made too long a program they should be divided into two groups on the basis of subject matter, not on the basis of the societies presenting them, and that simultaneous sessions should be held for such time as might be necessary. Conference with the executive officers of both societies after the meeting shows that this plan worked out to the satisfaction of all concerned with no friction or other unpleasant features save for some inconvenience to the secretaries growing out of a tardy beginning of the negotiations. A critical examination of the joint program shows, as it happens, that the two societies represented were very evenly balanced, both in number of papers submitted and in their scientific worth.

The plan here outlined is not recommended as an ideal, nor even a practicable, solution of the problem for every case, but it is mentioned as another illustration of the fact that the problem can be solved in a concrete case. Doubtless a different solution would have to be worked out for some other case.

In view of this history, the present writer, who is a loyal member of both Section F and the American Society of Zoologists, fails to see any reason why the societies should not have the advantages which would accrue to both by such an affiliation as was referred to above, uniting their forces for certain executive functions of national import, but leaving each free to work out the details of its organization in its own way. Either branch of the professional society would be able to meet independently at any time, but when the American Association meets in its region it should, as a rule, secure the advantages of joint sessions.

For my part, to be perfectly frank, I do not go to the national meetings primarily to hear papers read, much as I enjoy that feature, for these can generally be studied at leisure afterwards. As a comparative neurologist I, of course, want to get the first word of every advance movement in my specialty in this way; but I prize not less highly the opportunity possible only in a gathering of many different societies, of meeting my colleagues in related fields, by attending the Physiologists' and Anatomists' smokers, the Naturalists' dinner, and in other ways keeping in closer personal touch with the men who are doing the work in related departments of research on which I must so largely build. This is for me one of the most important gains that I win at the national meetings and one that can not be fully realized in any meeting of a single professional society, no matter how high the scientific standard or how wide a territory may be represented.

To secure this gain I, for one, am willing to make considerable sacrifices, though, as indicated above, these sacrifices do not necessarily include any loss in the efficiency or interest of the programs of convocation week. My own feeling is that in the final adjustment we shall probably come to a summer meeting of the association, with field excursions made prominent, some of the sections perhaps meeting in different places, and a convocation meeting in the winter devoted mainly to the reading of technical papers, with a due proportion of the time devoted to public discussions and lectures on themes of general scientific interest and to social intercourse. There should

be no difficulty in maintaining in these programs a scientific standard of papers read as high as that now presented by the professional societies. Indeed, there would be no impropriety, particularly in the case of any section which holds summer meetings, in relegating the reading of technical papers at the convocation meeting to the affiliated professional societies, the section, if possible, offering, in addition to the vice-presidential address, one or more set papers or discussions of more general interest.

The solution when finally wrought out will no doubt come by a process of evolution rather than by revolution, and the present trend is clearly in the direction of reserving the time of convocation week very largely for the reading of papers by the technical societies. Any attempt to force these societies into the summer months is foredoomed to failure.

C. JUDSON HERRICK.

THE CASE OF WILLIAM J. LONG.

TO THE EDITOR OF SCIENCE: The criticism of William J. Long's published observations on the habits of animals inaugurated so vigorously by John Burroughs in *The Atlantic Monthly* for March, 1903, and continued no less forcibly by William Morton Wheeler in your issue of February 26 arouses no little interest in the personality and methods of a writer whose work has met with so unfavorable a reception by naturalists.

Are we to believe the accusation that the author in question, to put the matter squarely, is a 'liar,' or have we in Mr. Long a naturalist whose powers of observation, discrimination and interpretation are so far beyond those of any other student of nature, living or dead, that he is in effect a Galileo among animal psychologists?

It can not be denied that Mr. Long, in spite of his youth, has placed upon record more remarkable statements regarding the behavior of the birds and mammals of New England and New Brunswick than can be found in all the authoritative literature pertaining to the animals of this region.

The story of the crows and their game with a china ring; of the kingfisher that stocked an isolated pool with fish in order that it might easily teach its young the art of fishing; of the partridge that repeatedly drummed a roll-call for the two missing members of a brood of eleven; of the red squirrel with cheek-pouches; of the porcupine that coiled in a ball before rolling down hill; of the loon that hatched its eggs, not by sitting on them, but by gathering them close to her side with her wing; of the woodcock that placed its broken leg in a plaster cast; of the ducks that have learned to drown salt-water mussels in fresh-water pools; of the great blue heron that scattered a pollywog in fragments on the water as bait to draw fish within spearing distance: these and many other equally remarkable observations and experiences are recounted with a circumstantial detail that carries conviction to all but the informed.

Indeed, one has not to read far in any of the half a dozen or more volumes which Mr. Long has produced to discover some more or less remarkable description of the actions of animals.

The nature of their contents and their undeniable literary merit furnish abundant reason, therefore, why Mr. Long's works should claim not only the attention of naturalists, but of the public generally, and again it may be asked, is the unsparing criticism to which they have been subjected warranted?

An apparently satisfactory reply to this query is furnished by a defense of Mr. Long published in the Boston *Evening Transcript*, March 7, 1903, and by Mr. Long himself. The writer of the *Transcript* communication seems to have been acquainted with Mr. Long at Andover Theological Seminary. After saying that Mr. Long prepared himself for college by 'solitary' study and that in entering the sophomore class he had not experienced that year in an undergraduate's life 'when a young man learns to take himself for very little,' he continues:

From both these circumstances it comes about that we have here a man easily tempted to overrate his personal knowledge, a man tempted to superficiality, a man likely to draw rash and ill-considered conclusions. It is also to be remembered that Mr. Long is of Irish extraction—inflammable, poetic and volatile in temperament.

No matter how great his learning up to a certain point, he is continually in peril of making irrational ventures beyond that point, lured forward by pure imagination. This has come out in his preaching. Eccentricities and extremely radical outbursts have had a disturbing effect upon his audiences and have limited his success. It is just this sort of thing that has made him the prey of Mr. Burroughs. I well remember an utterance of Mr. Long's in a class-room in Andover when he took issue with the professor, beginning by saying: 'I always love to think'—to which the professor replied, 'Mr. Long, we are not concerned with what we love to think, but with what we ought to think.' Here was the whole situation in a nutshell. What he has loved to think and not what he ought to think has colored whatever has met his eyes in the theological as well as the biological world.

Honest, absolutely honest, and yet not quite telling the truth—that is a seeming paradox, but a real paradox only as many a poetic temperament is itself a paradox, and any poetic temperament, any temperament to which imagination is all but reality, and to which the thing loved and, therefore, the thing sought, is by a natural consequence the thing believed—any such temperament will prepare bitter grief for itself when it enters the world of natural science. Scientists have always to guard against the personal equation. This is well illustrated in the disappearance from scientific use of the pencil sketch and its replacement by the photograph. Let me draw the strata in yonder rocks, and nine chances in ten I shall unconsciously draw into them the theory which I intend them to illustrate. The camera, on the other hand, tells no lies, and very plainly Mr. Long is some other thing than a camera. His finished product is art, not science; it is the forest plus Mr. Long; it is the woodland folk introduced, interpreted, beloved—I had almost said at the first, created by Mr. Long. And I wonder whether, after all, Mr. Burroughs is not equally writing his own delightful personality into his own charming pages. The world-wide difference comes in at one point only. Mr. Burroughs is temperamentally fitted to interpret nature through the forms of literature; Mr. Long is not so fitted.

Evidently the author of these illuminating paragraphs knew whereof he wrote, and his delineation of Mr. Long's peculiar characteristics appears to explain satisfactorily that gentleman's ability to make more startling discoveries in one short lifetime than have fallen to the lot of naturalists in preceding centuries. Additional light is thrown on Mr. Long's methods and their results by his confession that he has 'never studied nature consciously, but only loved it,' and has found out many of its 'ways long ago, guided solely by a boy's instinct' ('Ways of Wood Folk,' preface); while the dedication of 'Fowls of the Air' is a surprising avowal of its author's point of view. It reads:

To the Teachers of America who are striving to make nature study more vital and attractive by revealing a vast realm of nature outside the realm of Science, and a world of ideas above and beyond the world of facts, these studies from nature are dedicated.

To the naturalist further comment will be unnecessary, but it doubtless will be inquired why make all this disturbance about one of scores of inaccurate producers of so-called 'nature' books? Chiefly, it may be replied, because of the magnitude of Mr. Long's offenses, of the audience which he has won through his marked literary gifts in descriptive writing, and of the prominence injudicious criticism has brought him.

In a well-meant but somewhat ill-considered attempt to stamp out the fire, Mr. Burroughs merely scattered it. From an insignificant smudge, it has become a roaring blaze and its sparks are kindling throughout the land.

It requires the briefest consideration of the fact that tens of thousands of Mr. Long's books have been sold for supplementary reading in the schools—where, judged only by their literary charm, they are almost uniformly commended by teachers—to realize their far-reaching influence for evil. As I write, a prominent educational journal is received containing a review of Mr. Long's latest book, which the reviewer says, is 'by one who knows whereof he speaks, and who has studied so carefully and lovingly that he will make revelations that will hold us breathless.' This is a fair indication of the esteem in which Mr. Long and his works are held by the average teacher.

Is it not, then, the duty of naturalists to enlighten the general public, and especially those entrusted with the education of children,

in regard to the real character of Mr. Long's efforts to reveal 'a vast realm of nature outside the realm of science' in 'ideas above and beyond the world of facts'?

FRANK M. CHAPMAN.

AMERICAN MUSEUM OF NATURAL HISTORY.

### THE METRIC SYSTEM.

TO THE EDITOR OF SCIENCE: It is now years since the metric system has been authorized and permitted in this country and yet very little progress has been made in its practical introduction. We still labor with the old system. We can never tell in statistics or contracts what a ton of coal means (long or short) unless it is explicitly stated. And so in water analyses, they are stated in three or four different ways, so that it is hard to compare them. Even if we know they are in grains per gallon, it remains to be determined whether the gallon is imperial or U. S.

Allow me to suggest a method of introducing the metric system which might meet much less friction and meet all practical purposes.

The proposed legislation would be as follows:

1. On and after January 1, 1906, the U. S. standard ton shall be the metric ton, which shall contain 2,000 U. S. standard pounds, each of which shall contain 16 U. S. standard ounces. No other ounce, pound or ton weights, or weights purporting to be fractions or multiples thereof, shall be used under penalty.

2. The U. S. standard pint shall be the volume of one U. S. standard pound of pure water under certain conditions of temperature and pressure, and shall be equivalent to one-half liter. A quart shall be two such pints, and a gallon four such quarts, and a peck eight such quarts, and a bushel thirty-two such quarts, and no other measure of volume shall be permitted, the distinction between fluid and dry measure being abolished.

3.* The U. S. standard foot shall be the length of the edge of a cube which shall contain 1,000 U. S. standard ounces of water under certain conditions of temperature and pressure, *i. e.*, 62.5 U. S. standard pints. The popular use of the terms would not need be changed *at all*, and the actual change of units would be so slight (ten per cent. or less) that it would not popularly be noticed, as may appear from the following table:

| United States Standard. | | | | | | | | Metric. |
|---|---|---|---|---|---|---|---|---|
| .985 | present | ton | = | 1 | proposed | ton | = | 1 metric ton. |
| 1.102 | " | pounds | = | 1 | " | pound | = | $\frac{1}{2}$ Kilo., German 'Pfund.' |
| 1.102 | " | ounces | = | 1 | " | ounce | = | $\frac{1}{32}$ Kilo. = $31\frac{1}{4}$ grams. |
| 1.05671 | " | liquid pints | = | 1 | " | pint | = | $\frac{1}{2}$ liter. |
| .9081 | " | dry pint | = | 1 | " | quart | = | 1 liter |
| .9081 | " | " bushel | = | 1 | " | bushel | = | 32 liters. |
| 1.05671 | " | liquid gallons | = | 1 | " | gallon | = | 4 " |
| .984 | " | foot | = | 1 | " | foot | = | $\begin{cases} 25\sqrt[3]{2} \text{ cm.} \\ 315 \text{ cm.} \end{cases}$ |

Moreover, the old proverb, 'A pint is a pound the world around,' will be strictly true, and in water analyses a nickel's weight in a pint will be the same as an ounce per cubic foot and, specific gravity apart, the same as parts per thousand.

Especially in ending the long wrangle over various tons, I think the proposed changes would be decided improvements, and the differences between wet and dry measure should be abandoned.

ALFRED C. LANE.

### SEX DETERMINATION IN BEES AND ANTS.

IN SCIENCE for December 25, 1903, Professor W. M. Wheeler characterizes as lacking in critical caution and 'apodictic' the statement that 'the egg of the bee, if unfertilized, invariably develops into a male, but if fertilized into a female.' If Wheeler's objection is directed merely against the form of this statement and not against its general content, if he desires merely the eradication of the word

* This is not so essential to the scheme.

*invariably* and would see it replaced with *so far as observed,* I am quite ready to grant all that he desires. It scarcely requires explicit statement here that *all* conclusions of inductive science must be so qualified.

But if, as seems possible, Wheeler's objection extends farther and he would have us understand that the generalization made is supported by insufficient or uncritical observation, I would join issue with him sharply. Dzierzon's theory did not grow out of idle speculation, as a casual reading of Wheeler's article might lead one to suppose; it was the outgrowth of much careful observation and thought on the part of a keen-eyed bee-keeper. It won its way to general recognition in the face of bitter opposition and has successfully withstood for half a century repeated assaults from various sources, scientific and otherwise. A brief summary of the evidence on which it rests may not be out of place here.

1. Dzierzon showed more than fifty years ago* that mating of the queen-bee (the egg-laying female of the hive) does not take place within the hive, but high up in the air. It takes place, if at all, before the queen has begun to lay eggs, and occurs but once in the lifetime of the queen, viz., in what is called her 'nuptial flight.' For this flight she issues from the hive on a bright still day. Her seminal receptacle then contains only a thin watery fluid, as Dzierzon and his coworker, Berlepsch, found by dissection. When she returns, the seminal receptacle is swollen and opaque, crowded with spermatozoa. This observation we have on the added authority of von Siebold, who made microscopical examination of the seminal receptacle of a queen captured as she returned from the nuptial flight.

2. If for any reason the queen is unable to take the nuptial flight, as because she has crippled or defective wings, or because her wings have been artificially removed, she is not prevented thereby from laying eggs capable of development, but from such (unfertilized) eggs develop only bees of the male sex (drones). This conclusion, the outcome of repeated observations made by Dzierzon, Berlepsch and Bessels, is further supported by an experiment made by Berlepsch. He induced a hive of his bees to rear queens late in the season (near the end of September), after the drones had disappeared. One of these queens, which was wintered over, produced in the following spring some 1,500 cells of drone brood in worker cells. A dissection of this queen made by Leuckart showed that she really was, as expected, unimpregnated.

3. Worker bees, which are only imperfectly developed females, sometimes lay eggs capable of development. This frequently occurs after a hive has lost its queen. From such 'worker' eggs develop only male offspring. Dissections of egg-laying workers, which were made by Leuckart, revealed no seminal receptacle, hence the eggs of such animals can not have been fertilized.

4. Old queens, which possibly have exhausted or lost control of the supply of spermatozoa received at the nuptial flight, sometimes produce only drone offspring (in worker as well as in drone cells). An old but fruitful queen, which had been producing offspring of both sexes, was accidentally crushed toward the tip of the abdomen by Berlepsch, so seriously that he thought her dead, but she revived after about an hour and was replaced in the hive. All the eggs which she subsequently produced (and they numbered thousands) developed into drones. This case is, with a good show of reason, explained on the hypothesis that the genital organs of the queen were so injured by the accident that thereafter none of her eggs could be fertilized.

5. Queens which have mated in normal fashion subsequently lay eggs some of which are fertilized, others unfertilized. The fertilized eggs are deposited ordinarily only in the small worker cells or the very large queen cells, and they develop into females. The unfertilized eggs are deposited ordinarily only in the drone cells, and they develop into males.

* The original papers of Dzierzon were published in a bee journal now not generally accessible, *Die Bienenzeitung*, but extensive quotations from them are contained in the classical paper of von Siebold, 'Wahre Parthenogenesis bei Schmetterlingen und Bienen,' Engelmann, Leipzig, 1856. Other important papers on this subject are those of Bessels (1868), and Petrunkewitsch (1901, 1903).

That the eggs laid in such cases in worker cells are in reality fertilized, and those laid in drone cells unfertilized, has been established by direct observation. Von Siebold examined under the microscope 40 fresh laid eggs taken from worker cells; in 30 of these he was able to identify one or more spermatozoa; in three cases the spermatozoa were still moving. In 24 eggs taken from drone cells and carefully examined, no spermatozoa were seen. Von Siebold's observations are fully confirmed by results obtained by the more perfect methods of microscopical study now available. Petrunkewitsch (1901), who has recently made a careful study of the bee's egg by means of sections, found 61 ripe eggs taken from worker cells to have been fertilized, while in only one such egg he found no evidence of fertilization; on the other hand, 273 eggs taken from drone cells were all, with one exception, *unfertilized.* In this one egg the presence of a spermatozoon was indicated. That egg, however, can hardly rank as an undoubted exception to the perfectly obvious general rule. It may well have come from one of the cells of intermediate size on the border between the drone comb and the worker comb, from which either workers or drones may develop, or it may even have been introduced accidentally from worker comb into the lot of eggs in which it was found.

In favor of the view resurrected by Wheeler, that female bees may develop from unfertilized eggs, not a bit of trustworthy evidence has ever been presented, so far as I know. Certainly Wheeler presents none. The strongest support ever given to such an idea came from the experiments of Landois (1867). He transferred eggs from drone to worker cells and *vice versa,* and concluded that the sex of the bee produced depends upon the nature of the cell in which it develops, or more directly upon the character and amount of the food supplied to it. But Bessels (1868), who repeated the experiments of Landois, found that the workers regularly destroy eggs transferred from one cell to another, and the queen then lays new eggs in their stead. Berlepsch, however, as quoted by Bessels, by first removing the queen from the hive, and then by transferring a segment of the cell with the egg attached, succeeded in getting the workers to rear in worker cells a few eggs laid in drone cells. From these developed only drones!

But in the case of ants, Wheeler thinks it even a 'probability' that female ants develop from unfertilized eggs, and the title of his article would lead one to suppose this already a demonstrated fact. His conclusion certainly receives no support from the case of the honey-bee. We may accordingly reasonably ask for pretty clear evidence in its favor from some other source before accepting it as even *probable.* What evidence has Wheeler to present? Three different cases recorded by competent observers, in which worker ants have produced female offspring. But does it follow that the eggs from which these offspring developed were *unfertilized?* Clearly not. Because worker bees do not mate with drones, it does not follow that worker ants never mate with male ants. Indeed, Wheeler quotes Reichenbach, whom he characterizes as 'a very conscientious worker,' to the effect that in at least one species of ant, *Anergates atratulus,* 'fertilization always occurs normally within the nest.' If fertilization may occur within the nest, why may not the wingless worker mate with a male, as does the winged queen? At any rate, this possibility must first be excluded before we shall be justified in drawing the conclusion that all eggs laid by workers are necessarily *unfertilized* eggs. It is a possibility which two of the authorities cited by Wheeler, viz. Tanner and Reichenbach, distinctly recognize. They both emphasize the fact that the workers which under their observation produced female offspring 'had been living in community with males.'

Nor does the third authority, as cited by Wheeler, Mrs. A. B. Comstock, even suggest that the eggs laid by worker ants in the colony kept by her were *unfertilized* eggs. The credit for that idea belongs solely to Wheeler. What she records is that worker ants taken from out of doors laid in captivity eggs which developed into females. Is there any reason for supposing that the ants captured had not previously been with males? If not, then where-

in does this case differ from the other two?

May we not reasonably exercise some 'critical caution' before with Wheeler we conclude it probable 'that worker ants can really produce other workers or even queens parthenogenetically'? But suppose they can; wherein lies the 'ominous import' which such a possibility has for 'current views on sex determination'? For myself, I do not see that the case of the ant would then present any new problems not found either in the case of *Nematus*, or in the silk-moth, or in *Daphnia*, to any theory of sex determination ever conceived or conceivable. Should it be shown that the unfertilized eggs of the ant may develop either into males or into females (at present we have no evidence whatever that such is the case), then it would be in order to inquire whether all such eggs undergo two maturation divisions, as do the eggs of the bee, or whether, as in the Rotifera and Crustacea, male parthenogenetic eggs undergo *two* maturation divisions, whereas female parthenogenetic eggs undergo only one.

W. E. Castle.

Zoological Laboratory,
Harvard University,
January 25, 1904.

## SPECIAL ARTICLES.

### AMITOSIS IN THE EGG FOLLICLE CELLS OF INSECTS.

Professor Conklin's interesting account of the amitotically dividing egg follicle cells of the common crickets (*Gryllus pennsylvanicus, abbreviatus* and *domesticus*) in the *American Naturalist* for October, 1903, recalls attention to a condition and phenomenon in animal cytology all too little known. Despite the rarity of amitotic cell division elsewhere among animals, and the interest and significance of the phenomenon, the opportunity offered for its study in the egg follicle cells of insects has been taken little advantage of. We know simply that amitotic division occurs in some of these cells in certain insects. How consistently through the insect class; whether identical or varying in character among the different insect species in which it occurs; and finally and most importantly, how far back in the lineage (ancestry) of the cells themselves the phenomenon persists; in other words, at what time the amitotic division appears in the history of cells which must be derived from cells with mitosis; all these interesting questions remain to be answered. Professor Conklin finds that only in the follicle of the lowest egg-chamber of each ovarial tube of *Gryllus* are all the cells amitotically dividing. In the upper chambers or sections of the tubes the division of the cells is always (as far as observed) mitotic; in the lowest chamber, on the contrary, always amitotic.

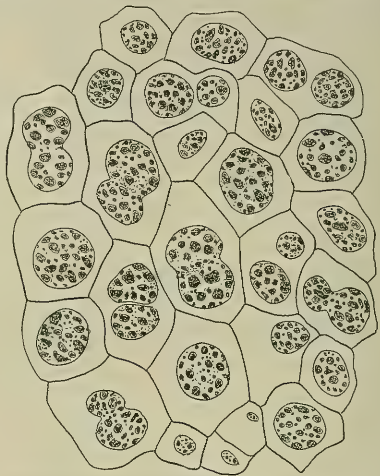

Fig. 1. Egg follicle cells of *Hydrophilus* sp.; showing amitotic division.

The obvious conclusion, in the light of our knowledge of the fate of the follicular cells of the lowest chamber—they secrete here the chorion of the egg and then give up the ghost—that the amitosis is a concomitant with senescence and decay, is probably indisputable. But it is a fact that in not all of the few insects in which this amitosis has been studied is it limited to the follicle cells of the last egg chamber.

Certain differences exist in the character of the amitosis of the egg follicle cells of *Gryllus* (as described by Professor Conklin)

and this process in the follicle cells of *Hydrophilus* sp., the common large water-scavenger beetle of our ponds and stream pools, as I have observed it. In the first place, amitosis is not confined to the lowest egg-chamber; unfortunately I can not say from my present preparations how far up the tube, *i. e.*, toward its germinal chamber, amitosis may be found among the follicle cells, but it is found above the last (lowest) chamber. In the second place, there is no well-defined single nucleolus. So the phenomenon of such a nucleolus surounded by a clear zone and regularly dividing before the nucleus (described for *Gryllus*) is wholly wanting in the follicle cells of *Hydrophilus*. Each nucleus of these cells contains a large number of spherical, strongly staining (chromatin) masses or grains gradating in size from a point up to conspicuously large nucleolus-like balls. The larger of these structures might be looked on as nucleolar masses, if one wanted to use the name nucleolus at all; but if so, from half a dozen to a score of nucleoli would have to be accepted and their only distinction (from the many smaller masses) would be the arbitrary one of size. Fig. 1 shows this disposition and relative massing of the staining (chromatin) substance in the nuclei. No sign of chromatin thread (linin or skein) is apparent. There is absolutely no sign of a division of these nucleoli or chromatin balls accompanying the nuclear division. The nuclei simply seem to be senescent structures with their chromatin content segregated into many small globular masses which vary in size, with all intermediate gradations from small to large. About each of the larger masses a narrow clear zone is apparent.

Fig. 1 shows also the various stages in the simple division of the nucleus and the great size of the nucleus compared with the cytoplasm body containing it. In some cases a cell wall appears between the daughter nuclei after division, but in others the cytoplasm does not seem to effect a clean division, both nuclei then lying, it may be said, in one cell. The actual size of the nuclei averages .04 mm.

VERNON L. KELLOGG.
STANFORD UNIVERSITY, CALIFORNIA.

### VARIATIONS IN THE PROTECTIVE VALUE OF THE ODORIFEROUS SECRETIONS OF SOME HETEROPTERA.

WHEN on a collecting trip near College Station, Texas, early in October, I examined the stomach contents of a half-grown toad. In this mass I found two stink-bugs (*Euschistus fissilis*). This seemed very interesting on account of the great amount of apparently more palatable insects available here; and especially interesting in connection with the fact that the examinations of the contents of 152 toads' stomachs since the summer of 1901, made to determine what rôle the common squash bug played in the toad's diet during a season when these bugs were exceptionally abundant, revealed less than three per cent. hemipterous material. Mr. Kirkland, in Bull. 46, Mass. Agric. Coll., p. 16, estimated the percentage of hemipterous and dipterous food, after careful examinations of 149 toads stomachs, below two per cent of the whole.

There are variations in the protective efficiency of the secretions of some heteroptera, and this may be an important factor in governing the percentage of diet such insects form with some animals. Many experiments with the common black squash bug were made during the summer of 1901 while at the New Hampshire Experiment Station, and the results there obtained showed that with constant use for a short time the secretions become weaker, and after fifteen minutes are decidedly less effective. Although toads in confinement were witnessed to eat squash bugs, it was only after the secretions were partially exhausted or where the bug was snatched before discharging the liquid. The greatest number a hungry toad would eat was three. In no case was this done in the face of a discharge from the secretion glands.

After twenty-four hours' rest under natural conditions the glands apparently regained maximum strength. This does not apply to hibernating specimens of heteroptera.

On September 15, 1901, half-grown toads were repeatedly killed from the full effects of the fresh discharges from several specimens of squash bugs.

On September 20, 1901, similar experiments required much more time to bring about similar results. Since then I have repeatedly killed half-grown toads in the same manner, while in a number of instances I was unable to kill any.

On October 5, 1903, while carrying 22 cotton boll weevils over a cotton plantation in a vial of 30 c.c. capacity three specimens of *Euschistus fissilis* were suddenly introduced. The secretions were powerfully ejected by these bugs when in the bottle, and in ten minutes the weevils were dead. This experiment was repeated the same day with equal success.

On October 14 and 18, 1903, repeated trials of the preceding experiments resulted in complete failures.

On December 2 four specimens of *Brochymena annulata* were put in a bottle of 45 c.c. capacity, and these killed a blow fly and three stable flies in nine minutes, and quieted a centipede in fifteen minutes, but the latter recovered.

On December 6, 1903, a repetition of the experiments of December 2 showed that twenty minutes more time was required to obtain similar results.

On December 9, 1903, the experiments of December 6 were failures.

On December 13, 1903, four fine specimens of *Brochymena annulata* were found hibernating under kindling wood. With these many experiments were made. They were put in the same vial used December 6 and 9, and when introduced in a warm room the secretions were discharged with much greater effect than in any of the above experiments. Two blow flies and two stable flies, each introduced separately, were killed in five minutes. After twenty minutes a centipede was introduced. Although motionless after eight minutes, the specimen recovered. After this time no more specimens could be killed, although many were introduced.

In all the experiments above referred to the vial was kept tightly corked except when specimens were introduced. Although other insects could be killed, the bugs themselves suffered, apparently, no inconvenience.

Albert F. Conradi.
Agricultural College,
College Station, Texas,
December 15, 1903.

## NOTES ON INORGANIC CHEMISTRY.

### MENDELÉEF'S CONCEPTION OF THE ETHER.

The *Chemisches Centralblatt* contains the abstract of a paper by Mendeléef published in the journal *Prometheus* on the subject of an attempted chemical explanation of the ether. From a realistic standpoint it is not satisfactory to ascribe to the ether the properties of weight and chemical individuality. It can not consist of matter now known, disseminated in an exceedingly attenuated condition, because it penetrates all matter, nor can it be the 'Urstoff,' since this would involve the possibility of the annihilation and evolution of atoms. It must rather be considered as a definite chemical substance so light that its molecular velocity is great enough to overcome gravitation; it is without chemical affinity; its power of diffusion is so great that it can penetrate all bodies, and hence can not be weighed, although it actually possesses an extremely small weight. Mendeléef would thus consider the ether to be the first member of the argon group in the periodic system, or what he calls the zero group, and places immediately before the alkali group. By extrapolation he posits an element in this group immediately before hydrogen, with an atomic weight of about 0.4. This he considers possibly identical with coronium. The ether must have a still smaller atomic weight, whose value, owing to this double extrapolation, is extremely doubtful, but certainly can not be over 0.17. For this ether as an element he proposes the name *Newtonium*. That the ether molecule can escape the attraction of the largest bodies of the universe its velocity must be, according to the kinetic theory of gases, at least 2,240 kilometers per second, and from this its atomic weight would be about one millionth that of hydrogen.

By means of this conception, it becomes possible to account for radio-activity, without

having recourse to what Mendeléef denominates the metachemical and vague ('verschwommene') theory of electrons. The radioactive atoms, with their high atomic weights, possess, as large centers of mass, the power of holding a relatively large number of ether atoms, though there is no chemical combination. The entrance and exit of these ether molecules from the groups is accompanied by those disturbances of the ethereal medium which cause the rays of light. The phosphorescence of bodies immersed in liquid air is caused by the increased absorption and condensation of ether molecules at low temperatures. The original article contains many other suggestive thoughts, such as the probability of a fifth halogen element, with atomic weight of about three, corresponding to the fifth metal of the alkalies.

### ATMOSPHERIC CORROSION OF ZINC.

A study of the action of the atmosphere upon zinc has recently appeared in the *Proceedings* of the Chemical Society (London), by G. T. Moody. Strips of thin sheet zinc were exposed for five months to the action of the atmosphere, with the result that the metal became completely covered with a half-crystalline coating of a basic carbonate, of formula $ZnCO_3, 3Zn(OH)_2$. From this it appears that the corrosion is to be ascribed, not to a direct oxidation, but to the action of the atmospheric carbonic acid. A confirmation of this was found in the fact that zinc dissolved in a saturated solution of carbon dioxid, the acid carbonate of zinc being formed, and on spontaneous evaporation a precipitate of basic carbonate was formed, of the same composition as that occasioned by atmospheric corrosion. While commercial hydrogen peroxid has a very rapid action on zinc, converting it into the hydroxid, pure hydrogen peroxid, even of thirty per cent. strength, is entirely without action, and the same is true regarding iron. Lead, on the other hand, is rapidly acted on by this reagent, being converted superficially into lead peroxid. Thus the action of the atmosphere on lead may be due to the presence of hydrogen peroxid, but this can not be the case with the corrosion of zinc and iron. That zinc is less corroded in the atmosphere than iron is attributed by Moody to the fact that so much of the carbonic acid is retained by the zinc in the form of basic carbonate, while in iron the carbonic acid is set free as soon as it has done its work, and thus keeps on in its attack upon the iron.

J. L. H.

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## *CURRENT NOTES ON METEOROLOGY.*

### METEOROLOGICAL PHENOMENA OF THE MONT PELÉE ERUPTION, JULY 9, 1902.

In the *Popular Science Monthly* for January, Professor T. A. Jaggar gives an account of the eruption of Pelée on July 9, 1902, in which several of the meteorological phenomena associated with the eruption are noted. One of the most striking features of the explosion was a great column of steam observed at 8 A.M. on July 11. "A vertical puff from the volcano rose 10,000 feet into the air, showing at first superb gray-brown cauliflower surfaces, and later taking on smooth outlines, with a funnel-shape and a feathery fringe." A similar steam column was observed on July 16, and a fine photograph was taken of it. The height of this latter column was between four and six miles. As clearly seen in the photograph, the upper part of the cloud was turned towards the east, showing the effect of the anti-trades. On July 9 the tops of a number of *cumulus* (? cumulo-nimbus) clouds were seen to be far below the black dome of volcanic dust. The dust in the air gave the moon a dim reddish-yellow appearance. No strong indraft of air towards the volcano was noted.

### DEMTSCHINSKY'S LONG-RANGE FORECASTS.

In the journal *Climat*, the publication of which was begun in 1901, and to which reference has been made in these notes, Demtschinsky, a Russian engineer, has been making public long-range weather forecasts, based chiefly on supposed lunar influences. These forecasts and the method used by Demtschinsky in making them, have lately been subjected to a critical study by Professor Klossovsky, of Odessa, the director of the Meteorological Service of southwestern Russia

('Examen de la méthode de la prédiction du temps de M. N. Demtschinsky,' Odessa, 1903, 8vo, pp. 74). The conclusions reached by Professor Klossovsky are distinctly unfavorable, as was to be expected. The author suggests that if M. Demtschinsky persists in issuing these forecasts, the whole matter should be taken up by the International Meteorological Committee. Dr. Klossovsky, in connection with his study of the Demtschinsky forecasts, summarizes briefly the present state of weather forecasting, and outlines the older method of mean values, the new method of synoptic meteorology, the use of analytical methods and the question of periodicity.

### THE 'LINE STORM' FALLACY.

In the annual summary of *Climate and Crops, New England Section,* a tabulation of daily precipitation between September 14 and 28 at Boston, during 32 years (1872–1903) is given, with a view to throwing light on the popular belief in the equinoctial storm. On September 21 measurable amounts of precipitation occurred but six times during the period, and for the week of which September 21 was the middle day, there have been but twelve years in which the total weekly precipitation was over one inch.

### THE CLIMATE OF IOWA.

The 'Annual Report of the Iowa Weather and Crop Service' (Des Moines, 1903) contains an appendix on 'Iowa Climate and Crops,' in which there is a good brief account of the climate of the state (pp. 11–23).

R. DeC. Ward.

Harvard University.

## RECENT ZOOPALEONTOLOGY.

### REVISED EDITION OF ZITTEL'S PALEONTOLOGY.

The first volume of the revised edition of von Zittel's 'Grundzüge der Paläontologie,'* which has just made its appearance, is a work of 558 pages covering the whole field of fossil invertebrates. It represents an enlargement of about forty pages over the original edition, with twenty new figures, but except for certain portions relating to the corals and echinoderms, there is essentially no change either in subject matter or in classification. The author remarks in the preface that he has duly considered the merits of the new system adopted in the English version, but has chosen to abide by the older established usage. In the case of the brachiopods and trilobites at least, there are many who will regard this as a backward step, where the studies of Beecher and others have resulted in as satisfactory a classification as exists in the animal kingdom, and it is rather a pity that in the choice of new figures, none of the classic illustrations showing stages of development in these groups were selected. Whether the vertebrate classes will be treated with equal conservatism remains to be seen when the second volume appears.

* 'Grundzüge der Paläontologie,' by K. A. von Zittel, Abth. I., 1903, R. Oldenbourg, Münich and Berlin.

### TERTIARY ELASMOBRANCHS FROM SOUTHERN ITALY.

Those interested in the distribution of Tertiary elasmobranchs will find this memoir of Dr. Pasquale,* a student of Professor F. Bassani at Naples, particularly useful, not only on account of the new data it contains, but also because of the careful comparisons the author has made with the type specimens of older writers, resulting in many cases in revised determinations. The various tables given at the end of the memoir are of great convenience. Signorina Pasquale has done for the Italian faunas what Leriche has recently accomplished in praiseworthy manner for the Belgian, in his memoir published by the Brussels Museum, and it is to be hoped that other localities will be taken up by paleichthyologists in similar close detail.

### JURASSIC FISHES FROM SPANISH LITHOGRAPHIC LIMESTONE.

Since the discovery made by L. Vidal a year or two ago of the occurrence of lithographic stone in northeastern Spain exactly comparable to that found in Bavaria and central France, a number of fossil remains have been

* 'Revisione dei Selaciane Fossili,' by Maria Pasquale, *Atti Accad. Sci. Napoli*, Vol. XII., No. 2, 1903.

described proving this formation to be contemporaneous with that of Cerin in the Bugey, which is referred by Lapparent and Haug to the summit of the Virgulien. Professor Sauvage,* the eminent director of the Boulogne Museum, now gives us an account of the piscine fauna so far as known from the new locality, which comprises in all thirteen species. The more important of these are illustrated in four photographic plates, amongst the number being a supposed chimæroid egg-case, certainly a very rare petrifaction. It is also interesting to note the presence of *Palæobatrachus* and ichthyosaurs in these beds.

FURTHER LIGHT ON THE TREMATASPIDÆ.

IN an interesting memoir of thirty-three pages published by the St. Petersburg Academy, Professor William Patten,† of Dartmouth, discusses the structure and classification of the primitive family of ostracaphores known as the Tremataspidæ. He describes with painstaking minutiæ the cephalic shield of *Trematаspis schmidti,* illustrating the same with two excellent plates. Our knowledge of this form has been increased by Patten's studies in several important particulars, such as regards the sensory canal system, arrangement of ventral plates, and number of incisions which are commonly regarded as branchial openings, but are interpreted by Patten as having served for the attachment of swimming appendages. Professor Patten's views in regard to arthropod affinities of ostracophores have recently been discussed by Dr. O. Jaekel in the *Zeitschrift der deutschen geologischen Gesellschaft,* and by the reviewer in the *American Naturalist.*

C. R. EASTMAN.

* 'Noticia sobre los Peces de la Caliza litográfica de la Provincia de Lérida,' by H. E. Sauvage. *Mem. R. Acad. de Ciencias y Artes de Barcelona,* Vol. IV., No. 35, 1903.

† 'On the Structure and Classification of the Trematаspidæ,' by William Patten, *Mém. Acad. Imp. Sci. St. Petersb.,* Vol. XIII., No. 5, 1903.

## SCIENTIFIC NOTES AND NEWS.

THE University of Pennsylvania has conferred its Doctorate of Science on William Healey Dall, of the U. S. Geological Survey and the U. S. National Museum.

DR. CHARLES S. MINOT, of Harvard Medical School, and Dr. Franklin P. Mall, of Johns Hopkins University, have been made members of the commission for Neurological Research, appointed by the International Association of Academies.

EDINBURGH UNIVERSITY will confer the honorary LL.D. on Dr. Alexander Macalister, professor of anatomy at Cambridge, and on Dr. Hannis Taylor, professor of constitutional and international law at Columbian University.

ST. ANDREWS UNIVERSITY will confer the degree of LL.D. on Dr. J. N. Langley, professor of physiology at Cambridge University.

THE French Geographical Society has awarded its great gold medal for 1904 to Sven Hedin, the Swedish explorer.

DR. NICHOLAS SENN, of Chicago, has been elected a member of the Swedish Medical Association.

ARRANGEMENTS are being made to celebrate the seventieth birthday of Professor Hugo Schiff, the Italian chemist.

PRESIDENT ROOSEVELT has received acceptances from five of those appointed as members of the Isthmian Canal Commission, namely, Rear Admiral John G. Walker, United States Navy, retired; Gen. George W. Davis, United States Army, retired; Col. Frank Hecker, of Detroit, director of transportation during the Spanish-American war; William Barclay Parsons, engineer of the New York subway, and William H. Burr, professor of engineering at Columbia University.

THE Royal Commission on London Traffic have nominated Sir John Wolfe Barry, one of the royal commissioners, Sir Benjamin Baker and Mr. W. Barclay Parsons, consulting engineer to the Board of Rapid Transit Railroad Commissioners of New York, to advise the commission on certain important technical questions connected with locomotion and transport in London.

DR. JAMES CRAUFORD DUNLOP has been appointed superintendent of statistics in the office of the registrar-general for Scotland, in place of the late Dr. Blair Cunyngham.

Mr. H. F. Newall has been appointed assistant director of the observatory of Cambridge University.

Professor Blaserna, of Rome, has been elected a foreign member of the French Physical Society.

Professor A. E. Austin, of the Tufts College Medical School, will pass the next seven months working in Ludwig's Biochemic Laboratory in Vienna.

Dr. D. H. Scott, F.R.S., has been elected president of the Royal Microscopical Society for the ensuing year.

M. d'Arsonval has been elected president of the French Physical Society.

M. Henri Cordier has been elected president of the Paris Geographical Society.

Dr. C. W. Hayes, of the U. S. Geological Survey, is giving a course of six lectures to the geological students of the Johns Hopkins University during the month of February. The lectures embrace a discussion of the structure of the Appalachian district and of the origin of some of the more important non-metallic deposits of economic value in the eastern and southern states.

Dr. Philip Jaisohn, late special adviser to the privy council of the king of Korea, lectured before the Geographical Society of Philadelphia on March 2 on 'Korea and its People.'

At the Royal Institution, London, Professor H. L. Callendar has begun a course of three lectures on 'Electrical Methods of Measuring Temperature,' and lectures have been announced for February 26 by Mr. Alexander Siemens, his subject being 'New Developments in Electric Railways'; for March 4, by Professor W. Stirling, on 'Breathing in Living Things'; and for March 11, by Professor F. T. Trouton, on 'The Motion of Viscous Substances.'

The Academy of Sciences at Berlin has held a meeting to celebrate the birthday of Frederick the Great and of the present German emperor. The principal address was made by Dr. Wilhelm Waldeyer, professor of anatomy.

On February 12, exercises commemorative of the centenary of the death of Immanuel Kant were held at the University of Alabama, at which short addresses were made by Dr. Edward F. Buchner, on the life of Kant and his influence on philosophy; by Dr. H. F. Sayre, on Kant in his relations to astronomy and physical science; by Dr. John Y. Graham, on Kant's contributions to the theory of evolution; by Professor T. W. Palmer, on his contributions to the development of mathematics, and by Mrs. J. Y. Graham, on Kant as a factor in the literature of Germany.

We learn from *Nature* that the hundredth anniversary of the death of Priestley was commemorated in Leeds by the congregation of Mill Hill Chapel, where Priestley was minister for some six years, and also by the Priestley Club. The members of the club, to the number of fifty, dined together, and the president, Dr. T. E. Thorpe, C.B., F.R.S., afterwards gave a public address on 'The Life and Work of Joseph Priestley,' in the Philosophical Hall. At Warrington on the same day, Dr. Thorpe unveiled a memorial tablet at the house which Priestley occupied during his stay in that town.

It is proposed to publish a volume commemorating the work of the late J. S. Budgett, of Trinity College, Cambridge, whose death we were recently compelled to record. A large part of the material collected by him in Africa has not been described, and it is intended that this shall be worked out by his friends and issued under the editorship of Professor J. Graham Kerr.

We regret to record the death of Sir Leslie Stephen, one of the great men of letters of the Victorian era, whose work was largely influenced by the scientific thought of the nineteenth century. His 'Science of Ethics,' published in 1882 and based largely on the theory of evolution, is a scientific work of importance.

The deaths are announced of Mr. W. G. MacMillan, secretary of the British Institution of Electrical Engineers and formerly lecturer on electrical engineering in Mason College, Birmingham; of Dr. Vassili Afanasieff, professor of pathological anatomy in the University of St. Petersburg, at the age of fifty-

five years; and of M. A. Laumonier, the French physician and botanist at the age of sixty-four.

THE senate passed the legislative, executive and judicial, and the agricultural appropriation bills on February 25.

MR. HENRY L. DOHERTY, president of the National Electric Light Association, has offered a gold medal for the best paper on underground construction for alternating or direct current plants.

THE foundation of Schnyder von Wartensee offers its prize of about $700 for an essay on the climate of Switzerland during the last thirty-seven years. Essays, which may be in English, should be sent before September 30, 1906, to the library at Zurich.

*Nature* states that the Municipal Council of Paris has adopted a proposal of M. Bussat for the foundation of a laboratory of applied physiology. M. Bussat has himself sketched out a scheme of the work which should be undertaken in such a laboratory, relating to the alimentary value of foodstuffs, muscular work, intoxication, etc., and he suggests that the director should give publicity to the work of the laboratory by means of courses of lectures addressed to the pupils of the professional and normal schools of Paris.

*Nature* states that it is proposed to hold a horticultural and gardening exhibition in the month of June next under the auspices of the Royal Botanic Society in the new exhibition grounds of the society, situated in the center of the Botanic Gardens in Regent's Park, London. The proposed scheme embraces horticulture, forestry, botany, educational methods, nature-study, and a special section for colonial produce. In addition to the exhibition, lectures and conferences are in course of arrangement.

ACCORDING to the London *Times* the British Board of Agriculture, through Mr. Brook Hunt, has asked the governors of the Southeastern Agricultural College, Wye, Kent, to consider a scheme for establishing local field stations for experiments and for providing special courses of training in the processes of agriculture. The board has also suggested the appointment of an instructor in poultry-rearing for the counties of Kent and Surrey. A scheme for establishing school gardens throughout the county of Kent is already under consideration. This, it is understood, has the approval of the Board of Agriculture, and no difficulty in obtaining their sanction for the expenditure of the necessary money is anticipated. The technical education funds of the county will bear the cost of the experiment.

PENNSYLVANIA'S commission for the World's Fair has applied for 3,500 square feet of space for its fish exhibit in the Forestry, Fish and Game Building, and has appropriated $10,000 for the display. A letter from Mr. W. E. Meehan, state fish commissioner of Pennsylvania, announces that he is prepared to put in thirty-five aquaria, as many as the United States Fish Commission will have in its exhibit in the Government Fisheries Building. Pennsylvania's exhibit will also 'include stuffed specimens of mammals, birds and reptiles that prey upon fish life, fishes of abnormal size, legal and illegal devices for taking fish, paintings in colors of the principal food and game fish of the state, state literature upon the subject of fish protection and culture, a miniature waterfall and trout stream, and a hatchery in full operation.'

THE United States Department of Agriculture has just issued 'Farmers' Bulletin No. 189,' 'Information concerning the Mexican Cotton Boll Weevil.' It was prepared by W. D. Hunter, special agent in charge of Cotton Boll Weevil Investigations, Division of Entomology. The work of the Division of Entomology for several years has demonstrated that there is not even a remote probability that the boll weevil will ever be absolutely exterminated. Although the very large yields of cotton of former years may perhaps no longer be possible, it is nevertheless entirely feasible to produce cotton at a margin of profit that will compare favorably with that involved in the production of most of the staple crops of the United States by what have become known generally as cultural methods. These methods consist of modifications of the system of cotton raising

made necessary by the weevil. They were originally suggested by a careful study of the life history and habits of the pest, and naturally any improvement that may eventually be made will be the result of the continuation of that study. They have been tested successfully on a large scale by the division of entomology, as well as by many planters, during two very unfavorable seasons. These methods are in brief as follows: First. Plant early. Second. Cultivate the fields thoroughly. Third. Plant the rows as far apart as experience with the land indicates is feasible, and thin out the plants in the rows thoroughly. Fourth. Destroy, by plowing up, windrowing, and burning, all the cotton stalks in the fields as soon as the weevils become so numerous that practically all the squares and bolls are being punctured. Of greatest advantage is the reducing for the next year of the number of the weevils by the destruction of the plants in the fall. The advantage thus gained is followed by bending every effort toward procuring an early crop the following season. Fifth. While fertilizers are not now used to any considerable extent in cotton producing in Texas, there is no doubt that they should be; not that the land is poor, but that crops may be procured earlier so as to avoid a considerable degree of injury by the weevil, which is more destructive to later crops. The bulletin contains a description of the weevil, the territory affected, and the plan of the investigations by the division of entomology, and gives some of the results of the field work and an experiment showing the damage resulting from favorable hibernating quarters. The bulletin concludes with an account of the legal restrictions concerning the shipment of infested cotton seed and a warning to cotton planters against the inflation of prices of the seed of certain varieties, and the attempts of unscrupulous persons to dispose of common seed from various localities as that of early maturing varieties.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

The presidents of seven New York universities and colleges—Syracuse, Rochester, Union, Colgate, St. Lawrence, New York, University and Hamilton have appeared before the senate finance committee at Albany, to urge the adoption of a substitute instead of the proposed bill appropriating $250,000 for the erection of an agricultural hall at Cornell University.

The supreme court of New Jersey has rendered a mandamus directing the state comptroller to issue a warrant on the state treasury for $80,000 in favor of Rutger's College. The money is due for scholarships established by the legislature, and has remained unpaid for a long time on the contention that the legislative act relating to scholarships was unconstitutional.

Mr. Philip H. Walker has given £1,200 to Oxford University, to establish a studentship in pathology.

The new buildings for the Medical School, the Sedgwick Geological Museum, the Botanical Library and the Law School of Cambridge University were opened on March 1.

On February 19, fire completely destroyed the building at the Ohio State University containing the Departments of Chemistry, Pharmacy, Metallurgy and Mining Engineering. The loss is estimated at $100,000.

The course in economic geology at The University of Chicago this year consists of a double study for twelve weeks. The course is divided into two parts: 'The Non-metallic Mineral Resources,' and 'The Metallic Mineral Resources.' The first part was given Dr. E. R. Buckley, director of the Missouri Bureau of Geology and Mines and the second part is being given by Dr. H. Foster Bain, geologist of the U. S. Geological Survey.

The following have been appointed electors, at the University of Cambridge, to the professorships indicated: chemistry, Professor J. J. Thomson; anatomy, Sir M. Foster; botany, Professor Clifford Allbutt; Jacksonian (chemistry), Sir William Ramsay; Downing (medicine), Sir M. Foster; zoology, Mr. J. W. Clark; physics, Professor R. B. Clifton; physiology, Professor Clifford Allbutt; surgery, Sir Frederick Treves, Bart.; pathology, Professor R. Muir.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 11, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

## THE MESSAGE OF NON-EUCLIDEAN GEOMETRY.*

### 1. MATHEMATICS AND ITS HISTORY.

THE great Sylvester once told me that he and Kronecker, in attempting a definition of mathematics, got so far as to agree that it is poetry.

But the history of this poesy is itself poetry, and the creation of non-Euclidean geometry gives new vantage-ground from which to illuminate the whole subject, from before the time when Homer describes Proteus as finger-fitting-by-fives, or counting, his seals, past the epoch when Lagrange, confronted with the guillotine and asked how he can make himself useful in the new world, answers simply, 'I will teach arithmetic.'

Who has not wished to be a magician like the mighty Merlin, or Dr. Dee, who wrote a preface for the first English translation of Euclid, made by Henricus Billingsley, afterward, Aladdin-like, Sir Henry Billingsley, Lord Mayor of London?

Was not Harriot, whose devices in algebra our schoolboys now use, one of the three paid magi of the Earl of Northumberland? Do not our every-day numerals stand for Brahmin and Mohammedan, coming first into Europe from the land of the sacred Ganges, around by the way of the pyramids and the Moorish Alhambra?

* Address of the vice-president and chairman of Section A, American Association for the Advancement of Science, St. Louis meeting, December, 1903.

The appearance of courses on the history of mathematics in all our foremost universities is a fortunate and promising sign of the times. I had the honor of being the first to give such a course in America, at Princeton, in 1881.

2. GEOMETRY AND ITS FOUNDERS.

But something especially fascinating, pure, divine, seems to pertain to geometry. When asked how God occupies himself, Plato answered, 'He geometrizes continually.'

It is a difficult, though highly interesting, undertaking to investigate the vestiges of primitive geometry. Geometric figures and designs appear in connection with the primitive arts; for example, the making of pottery. Arts long precede anything properly to be called science. The first creations by mankind are instruments for life, though it is surprising how immediately decoration appears; witness the sketches from life of mammoth and mastodon and horses by prehistoric man. But, in a sense, even the practical arts must be preceded by theoretical creative acts of the human mind. Man is from the first a creative thinker. Perhaps even some of our present theoretical presentation of the universe is due to creative mental acts of our pre-human ancestors. For example, that we inevitably view the world as consisting of distinct individuals, separate, distinct things, is a prehuman contribution to our working theory and representation of the universe. It is conscious science, as a potential presentation and explanation of everything, which comes so late.

Rude instruments were made for astronomy.

The creative imagination which put the bears and bulls and crabs and lions and scorpions into the random-lying stars made figures which occur in the Book of Job, more ancient than Genesis itself.

The daring astrologer, whose predictions foretold eclipses, saw no reason why his constructions should not equally fit human life. He chose to create a causal relation between the geometric configurations of the planets and the destinies of individuals. This was the way of science, where thought precedes and helps to make fact. No description or observation is possible without a precedent theory, which stays and sticks until some mind creates another to fight it, and perhaps to overshadow it.

That legend of the origin of geometry which attributes it to the necessity of refixing land boundaries in Egypt, where all were annually obliterated by the Nile overflow, is a too-ingenious hypothesis, made temporarily to serve for history. Some practical devices for measurement arose in Egypt, where periodic fertility fostered a consecutive occupancy, whose records, according to Flinders Petrie, we have for more than nine thousand years.

But in the Papyrus of the Rhind, measurements of volume come before those for surface.

Geometry as a self-conscious science waits for Thales and Pythagoras.

We find in Herodotus that Thales predicted an eclipse memorable as happening during a battle between the Lydians and Medes. The date was given by Baily as B. C. 610.

So we know about when geometry, we may say when science, began; for though primarily geometer, Thales taught the sphericity of the earth, was acquainted with the attracting power of magnetism, and noticed the excitation of electricty in amber by friction.

A greater than he, Pythagoras, was born B. C. 590 at Samos, traveled also into Egypt and the east, penetrating even into India. Returning in the time of the last Tarquin, and finding Samos under the dominion of the tyrant Polycrates, he went

as a voluntary exile to Italy, settled at Croton (as Ovid mentions), and there created and taught new and sublimer hypotheses for our universe. The most diversely demonstrated and frequently applied theorem of geometry bears his name. The first solution of a problem in that most subtle and final of ways, by proving it impossible, is due to him; his solution of the problem to find a common submultiple of the hypothenuse and side of an isosceles right triangle, an achievement whereby he created incommensurability.

It is noteworthy that this making of incommensurables is confused by even the most respectable of the historians of mathematics with the creation of irrational numbers. But in the antique world there were no such numbers as the square root of two or the square root of three. Such numbers can not be discovered, and it was centuries before they were created. The Greeks had only rational numbers.

### 3. EUCLID.

Under the Horseshoe Falls at Niagara press on beyond the guide; risk life for the magnificent sensation of a waterspout, a cloudburst, an avalanche, a tumbling cathedral of waterblocks! It *must* end in an instant, this extravagant downpour of whole wealths of water. Then out; and look away down the glorious canyon, and read in that graven history how this momentary riotous chaos has been just so, precisely the same, for centuries, for ages, for thousands of years.

In the history of science a like antithesis of sensations is given by Euclid's geometry.

In the flood of new discovery and rich advance recorded in books whose mere names would fill volumes, we ask ourselves how any one thing can be permanent? Yet, looking back, we see this Euclid not only cutting his resistless way through the rock of the two thousand years that make the history of the intellectual world, but, what is still more astounding, we find that the profoundest advance of the last two centuries has only served to emphasize the consciousness of Euclid's perfection.

Says Lyman Abbott, if you want an infallible book go not to the Bible, but to Euclid.

In 'The Wonderful Century,' Alfred Russel Wallace says, speaking of all time before the seventeenth century: "Then going backward, we can find nothing of the first rank except Euclid's wonderful system of geometry, perhaps the most remarkable product of the earliest civilizations."

Says Professor Alfred Baker, of the University of Toronto: "Of the perfection of Euclid (B. C. 290) as a scientific treatise, of the marvel that such a work could have been produced two thousand years ago, I shall not here delay to speak. I content myself with making the claim that, as a historical study, Euclid is, perhaps, the most valuable of those that are taken up in our educational institutions."

At its very birth this typical product of the Greek genius assumed sway over the pure sciences. In its first efflorescence, through the splendid days of Theon and Hypatia, fanatics could not murder it as they did Hypatia, nor later could that dismal flood, the dark ages, drown it. Like the phœnix of its native Egypt it rises anew with the new birth of culture. An Anglo-Saxon, Adelhard of Bath, finds it clothed in Arabic vestments in the Moorish land of the Alhambra.

In 1120, Adelhard, disguised as a Mohammedan student, went to Cordova, obtained a Moorish copy of Euclid's 'Elements,' and made a translation from the Arabic into Latin.

The first translation into English (1570) was made by 'Henricus Billingsley,' afterward Sir Henry Billingsley, Lord Mayor of London, 1591. And up to this very

year, throughout the vast system of examinations carried on by the British government, by Oxford and by Cambridge, to be accepted, no proof of a theorem in geometry should infringe Euclid's sequence of propositions. For two millenniums his axioms remained undoubted.

### 4. THE NEW IDEA.

The break from Euclid's charmed circle came not at any of the traditional centers of the world's thought, but on the circumference of civilization, at Maros-Vásárhely and Temesvár, and again at Kazan on the Volga, center of the old Tartar kingdom; and it came as the creation of a willful, wild Magyar boy of twenty-one and an insubordinate young Russian, who, a poor widow's son from Nijni-Novgorod, enters as a charity student the new university of Kazan.

The new idea is to deny one of Euclid's axioms and to replace it by its contradictory. There results, instead of chaos, a beautiful, a perfect, a marvelous new geometry.

### 5. HOW THE NEW DIFFERS FROM THE OLD.

Euclid had based his geometry on certain axioms or postulates which had in all lands and languages been systematically used in treatises on geometry, so that there was in all the world but one geometry. The most celebrated of these axioms was the so-called parallel-postulate, which, in a form due to Ludlam, is simply this: 'Two straight lines which cut one another can not *both* be parallel to the same straight line.'

Now this same Magyar, John Bolyai, and this Russian, Lobachevski, made a geometry based not on this axiom or postulate, but on its direct contradiction. Wonderful to say, this new geometry, founded on the flat contradiction of what had been forever accepted as axiomatic, turned out to be perfectly logical, true, self-consistent and of marvelous beauty. In it many of the good old theorems of Euclid and our own college days are superseded in a surprising way. Through any point outside any given straight line can be drawn an infinity of straight lines in the same plane with the given line, but which nowhere would meet it, however far both were produced.

### 6. A CLUSTER OF PARADOXES.

In Euclid, Book I., Proposition 32 is that the sum of the angles in every rectilineal triangle is *just exactly* two right angles. In this new or non-Euclidean geometry, on the contrary, the sum of the angles in every rectilineal triangle is *less* than two right angles.

In the Euclidean geometry parallels *never* approach. In this non-Euclidean geometry parallels *continually* approach.

In the Euclidean geometry all points equidistant from a straight line are on a *straight* line. In this non-Euclidean geometry all points equidistant from a straight line are on a *curve* called the equidistantial.

In the Euclidean geometry the limit approached by a circumference as the radius increases is a *straight* line. In the non-Euclidean geometry this is a *curve* called the oricycle. Thus the method of Kempe's book 'How to draw a straight line,' would here draw not a straight line, but a curve.

In the Euclidean geometry, if three angles of a quadrilateral are right, then the fourth is *right*, and we have a rectangle. In this non-Euclidean geometry, if three angles of a quadrilateral are right, then the fourth is *acute*, and we never can have any rectangle.

In the Euclidean geometry two perpendiculars to a line remain *equidistant*. In this non-Euclidean geometry two perpendiculars to a line *spread away from each other* as they go out; their points two

inches from the line are farther apart than their points one inch from the line.

In the Euclidean geometry every three points are either on a *straight* line or a *circle*. In this non-Euclidean geometry there are triplets of points which are neither *costraight* nor *concyclic*. Thus three points each one inch above a straight line are neither on a straight line nor on a circle.

### 7. MISTAKE OF THE INEXPERT.

These seeming paradoxes could be multiplied indefinitely, and they form striking examples of this new geometry. They seem so bizarre, that the first impression produced on the inexpert is that the traditional geometry could easily be proved, as against this rival, by careful experiments. Into this error have fallen Professors Andrew W. Phillips and Irving Fisher, of Yale University. In their 'Elements of Geometry,' 1898, page 23, they say: "Lobachevski proved that we can never get rid of the parallel axiom without assuming the space in which we live to be very different from what we know it to be through experience. Lobachevski tried to imagine a different sort of universe in which the parallel axiom would not be true. This imaginary kind of space is called *non-Euclidean* space, whereas the space in which we really live is called *Euclidean*, because Euclid (about 300 B. C.) first wrote a systematic geometry of our space."

Now, strangely enough, no one, not even the Yale professors, can ever prove this naïve assertion. If any one of the possible geometries of uniform space could ever be proved to be the system actual in our external physical world, it certainly could not be Euclid's.

Experience can never give, for instance, such absolutely exact metric results as precisely, perfectly two right angles for the angle sum of a triangle. As Dr. E. W. Hobson says: "It is a very significant fact that the operation of counting, in connection with which numbers, integral and fractional, have their origin, is the one and only absolutely exact operation of a mathematical character which we are able to undertake upon the objects which we perceive. On the other hand, all operations of the nature of measurement which we can perform in connection with the objects of perception contain an essential element of inexactness. The theory of exact measurement in the domain of the ideal objects of abstract geometry is not immediately derivable from intuition."

### 8. THE ARTIFICIALLY CREATED COMPONENT IN SCIENCE.

In connecting a geometry with experience there is involved a process which we find in the theoretical handling of any empirical data, and which, therefore, should be familiarly intelligible to any scientist.

The results of any observations are always valid only within definite limits of exactitude and under particular conditions. When we set up the axioms, we put in place of these results statements of absolute precision and generality. In this idealization of the empirical data our addition is at first only restricted in its arbitrariness in so much as it must seem to approximate, must apparently fit, the supposed facts of experience, and, on the other hand, must introduce no logical contradiction. Thus our actual space to-day may very well be the space of Lobachevski or Bolyai.

If anything could be proved or disproved about the nature of space or geometry by experiments, by laboratory methods, then our space could be proved to be the space of Bolyai by inexact measurements, the only kind which will ever be at our disposal. In this way it might be known to be *non*-Euclidean. It never can be known to be Euclidean.

### 9. DARWINISM AND GEOMETRY.

The doctrine of evolution as commonly expounded postulates a world independent of man, and teaches the production of man from lower forms of life by wholly natural and unconscious causes. In this statement of the world of evolution there is need of some rudimentary approximative practical geometry.

The mighty examiner is death. The puppy, though born blind, must still be able to superimpose his mouth upon the source of his nourishment. The little chick must be able, responding to the stimulus of a small bright object, to bring his beak into contact with the object so as to grasp and then swallow it. The springing goat, that too greatly misjudges an abyss, does not survive and thus is not the fittest.

So, too, with man. We are taught that his ideas must in some way and to some degree of approximation correspond to this independent world, or death passes upon him an adverse judgment.

But it is of the very essence of the doctrine of evolution that man's knowledge of this independent world, having come by gradual betterment, trial, experiment, adaptation, and through imperfect instruments, for example the eye, can not be metrically exact.

If two natural hard objects, susceptible of high polish, be ground together, their surfaces in contact may be so smoothed as to fit closely together and slide one on the other without separating. If now a third surface be ground alternately against each of these two smooth surfaces until it accurately fits both, then we say that each of the three surfaces is approximately plane. If one such plane surface cut through another, we say the common boundary or line where they cross is approximately a straight line. If three approximately plane surfaces on objects cut through a fourth, in general they make a figure we may call an approximate triangle. Such triangles vary greatly in shape. But no matter what the shape, if we cut off the six ends of any two such and place them side by side on a plane with their vertices at the same point, the six are found, with a high degree of approximation, just to fill up the plane about the point. Thus the six angles of any two approximate triangles are found to be together approximately four right angles.

Now, does the exactness of this approximation depend only on the straightness of the sides of the original two triangles, or also upon the size of these triangles?

If we know with absolute certitude, as the Yale professors imagine, that the size of the triangles has nothing to do with it, then we know something that we have no right to know, according to the doctrine of evolution; something impossible for us ever to have learned evolutionally.

### 10. THE NEW EPOCH.

Yet before the epoch-making ideas of Lobachevski and John Bolyai every one made this mistake, every one supposed we were perfectly sure that the angle-sum of an actual approximate triangle approached two right angles with an exactness dependent only on the straightness of the sides, and not at all on the size of the triangle.

### 11. THE SLIPS OF PHILOSOPHY.

The Scotch philosophy accounted for this absolute metrically exact knowledge by teaching that there are in the human mind certain synthetic theorems, called intuitions, supernaturally inserted there. Dr. McCosh elaborated this doctrine in a big book entitled 'The Intuitions of the Mind Inductively Investigated.' One of these supernatural intuitions was Euclid's parallel-postulate! *Voilà!*

'Yet,' to quote a sentence from Wenley's

criticism in SCIENCE, of McCosh's disciple Ormond, 'we may well doubt whether a thinker, standing with one foot firmly planted on the Rock of Ages and the other pointing heavenward, has struck the attitude most conducive to progress.'

Kant, supposing that we knew Euclid's geometry and Aristotle's logic to be true absolutely and necessarily, accounted for the paradox by teaching that this seemingly universal synthetic knowledge was in reality particular, being part of the apparatus of the human mind itself.

But now the very foundations are cut away from under the Kantian system of philosophy by this new geometry which is in simple and perfect harmony with experience, with experiment, with the properties of the solid bodies and the motions about us. Thus this new geometry has given explanation of what in the old geometry was accepted without explanation.

### 12. WHAT GEOMETRY IS.

At last we really know what geometry is. Geometry is the science created to give understanding and mastery of the external relations of things; to make easy the explanation and description of such relations, and the transmission of this mastery. Geometry is the most perfect of the sciences. It precedes experiment and is safe above all experimentation.

The pure idea of a plane is something we have made, and by aid of which we see surfaces as perfectly plane, over-riding imperfections and variations, which themselves we can see only by help of our self-created precedent idea. Just so the straight line is wholly a creation of our own.

### 13. ARE THERE ANY LINES?

I was once consulted by an eminent theologian and a powerful chemist as to whether there are really any such things as lines. I drew a chalk-mark on the blackboard, and used the boundary idea. Along the sides of the chalk-mark is there a common boundary where the white ends and the black begins, neither white nor black, but common to both?

Said the theologian, yes. Said the chemist, no.

Though lines are my trade, I sympathized with the chemist.

There is nothing there until I create a line and then see it there, if I may say I see what is an invisible creation of my mind.

Geometry is in structure a system of theorems deduced in pure logical way from certain unprovable assumptions precreated by auto-active animal and human minds.

### 14. THE REQUIREMENT OF RIGOR IN REASONING.

Some unscientific minds have a personal antipathy to 'a perfect logical system,' 'deduced logically from simple fundamental truths.' But as Hilbert says: "The requirement of rigor, which has become proverbial in mathematics, corresponds to a universal philosophic necessity of our understanding; and, on the other hand, only by satisfying this requirement do the thought content and the suggestiveness of the problem attain their full effect. Besides, it is an error to believe that rigor in the proof is the enemy of simplicity. On the contrary, we find it confirmed by numerous examples that the rigorous method is at the same time the simpler and the more easily comprehended. The very effort for rigor forces us to find out simpler methods of proof.

"Let us look at the principles of analysis and geometry. The most suggestive and notable achievements of the last century in this field are, as it seems to me, the arithmetical formulation of the concept

of the continuum, and the discovery of non-Euclidean geometry.''

The importance of the advance they had made was fully realized by John Bolyai and Lobachevski, who claimed at once, unflinchingly, that their discovery or creation marked an epoch in human thought so momentous as to be unsurpassed by anything recorded in the history of philosophy or science, demonstrating, as had never been proved before, the supremacy of pure reason, at the very moment of overthrowing what had forever seemed its surest possession, the axioms of geometry.

### 15. THE YOUTH LOBACHEVSKI.

Young Lobachevski at the University of Kazan, though a charity student, and, as seeking a learned career, utterly dependent on the authorities, yet plunged into all sorts of insubordination and wildness. Among other outbursts, one night at eleven o'clock he scandalized the despotic Russian authorities of the Tartar town by shooting off a great skyrocket, which prank put him promptly in prison. However, he continued to take part in all practical jokes and horse-play of the more daring students, and the reports of the commandant and inspector are never free from bitter complaints against the outrageous Lobachevski. His place as 'Kammerstudent' he lost for too great indulgence toward the misbehavior of the younger students at a Christmas festivity. In spite of all, he ventured to attend a strictly forbidden masked ball, and what was worse, in discussing the supposed interference of God to make rain, etc., he used expressions which subjected him to the suspicion of atheism. From the continual accusing reports of the commandant to the Rektor, the latter took a grudge against the troublesome Lobachevski, and reported his badness to the curator, who, in turn, with expressions of intense regret that Lobachevski should so tarnish his brilliant qualities, said he would be forced to inform the minister of education. Lobachevski seemed about to pay dear for his youthful wantonness. He was to come up as a candidate for the master's degree, but was refused by the senate, explicitly because of his bad behavior. But his friend, the foreign professor of mathematics, now rallied the three other foreign professors to save him, if he would appear before the senate, declare that he rued his evil behavior, and solemnly promise complete betterment.

This was the mettle of the youth, the dare-devil, the irrepressible, who startled the scientific sleep of two thousand years, who contemptuously overthrew the great Legendre, and stood up beside Euclid, the god of geometers; this the Lobachevski who knew he was right against a scornful world, who has given us a new freedom to explain and understand our universe and ourselves.

### 16. THE BOY BOLYAI.

Of the boy Bolyai, joint claimant of the new world, we have a brief picture by his father. ''My $(13 + \frac{1}{4})$ year old son, when he reached his ninth year, could do nothing more than speak and write German and Magyar, and tolerably play the violin by note. He knew not even to add. I began at first with Euclid; then he became familiar with Euler; now he not only knows of Vega (which is my manual in the college) the first two volumes completely, but has also become conversant with the third and fourth volumes. He loves differential and integral calculus, and works in them with extraordinary readiness and ease. Just so he lightly carries the bow through the hardest runs in violin concerts. Now he will soon finish my lectures on physics and chemistry. On these once he also passed with my grown pupils a public examination given in the Latin language, an

examination worthy of all praise, where in part others questioned him *ad aperturam*, and in part, as opportunity served, I let him carry out some proofs in mechanics by the integral calculus, such as variable motion, the *tautochronism* of the cycloid, and the like. Nothing more could be wished. The simplicity, clearness, quickness and ease were enrapturing even for strangers. He has a quick and comprehensive head, and often flashes of *genius*, which many paths at once with a glance find and penetrate. He loves pure deep theories and astronomy. He is handsome and rather strongly built, and appears restful, except that he plays with other children very willingly and with fire. His character is, as far as one can judge, firm and noble. I have destined him as a sacrifice to mathematics. He also has consecrated himself thereto.''

His mother, née Zsuzsanna Benkö Arkosi, wonderfully beautiful, fascinating, of extraordinary mental capacity, but always nervous, so idolized this only child that when in his fifteenth year he was to be sent to Vienna to the K. K. Ingenieur-Akademie, she said it seemed he should go, but his going would drive her distracted. And so it did.

Appointed 'sous-lieutenant,' and sent to Temesvár, he wrote thence to his father a letter in Magyar, which I had the good fortune to see at Maros-Vásárhely:

*My Dear and Good Father:*

I have so much to write about my new inventions that it is impossible for the moment to enter into great details, so I write you only on one fourth of a sheet. I await your answer to my letter of two sheets; and perhaps I would not have written you before receiving it if I had not wished to address to you the letter I am writing to the Baroness, which letter I pray you to send her.

First of all I reply to you in regard to the binomial.

* * * * * * * *

Now to something else, so far as space permits.

I intend to write, as soon as I have put it into order, and when possible to publish, a work on parallels.

At this moment it is not yet finished, but the way which I have followed promises me with certainty the attainment of the goal, if it in general is attainable.

It is not yet attained, but I have discovered such magnificent things that I am myself astonished at them. It would be damage eternal if they were lost. When you see them, my father, you yourself will acknowledge it.

Now I can not say more, only so much: *that from nothing I have created another wholly new world.*

All that I have hitherto sent you compares to this only as a house of cards to a castle.

P. S.—I dare to judge absolutely and with conviction of these works of my spirit before you, my father; I do not fear from you any false interpretation (that certainly I would not merit), which signifies that, in certain regards, I consider you as a second self.

Nor was the young Magyar deceived. The early flashings of his genius culminated here in a piercing search-light penetrating and dissolving the enchanted walls in which Euclid had for two thousand years held captive the human mind.

The potential new universe, whose creation this letter announces, afterward set forth with master strokes in his 'Science Absolute of Space,' contains the old as nothing more than a special case of the new.

Already all the experts of the mathematical world are his disciples.

### 17. SOLVING THE UNIVERSE.

Henceforth the non-Euclidean geometry must be reckoned with in all culture, in all scientific thinking. It shows that the riddle of the universe is an indeterminate equation capable of entirely different sets of solutions. It shows that our universe is largely man-made, and must be often remade to be solved.

In Science for November 20, 1903, page 643, W. S. Franklin, under a heading for

which he shows scant warrant, expresses himself after the following naïve fashion:

A clear understanding of the essential limitations of systematic physics is important to the engineer; it is I think equally important to the biologist, and it is of vital importance to the physicist, for, in the case of the physicist, to raise the question as to limitations is to raise the question as to whether his science does after all deal with realities, and the conclusion which must force itself on his mind is, I think, that his science, the systematic part of it, comes very near indeed to being a science of unrealities.

Of course, we deeply sympathize with this seemingly sad perception, with its accompanying 'simple weeps,' 'trailing weeps' and 'steady weeps,' but are tempted to prescribe a tonic or bracer in the form of a correspondence course in non-Euclidean geometry.

At least in part, space is a creation of the human mind entering as a subjective contribution into every physical experiment. Experience is, at least in part, created by the subject said to receive it, but really in part making it.

In rigorously founding a science, the ideal is to create a system of assumptions containing an exact and complete description of the relations between the elementary concepts of this science, its statements following from these assumptions by pure deductive logic.

### 18. GEOMETRY NOT EXPERIMENTAL.

Now, geometry, though a natural science, is not an experimental science. If it ever had an inductive stage, the experiments and inductions must have been made by our pre-human ancestors.

Says one of the two greatest living mathematicians, Poincaré, reviewing the work of the other, Hilbert's transcendently beautiful 'Grundlagen der Geometrie':

What are the fundamental principles of geometry? What is its origin; its nature; its scope? These are questions which have at all times engaged the attention of mathematicians and thinkers, but which took on an entirely new aspect, thanks to the ideas of Lobachevski and of Bolyai.

For a long time we attempted to demonstrate the proposition known as the *postulate of Euclid;* we constantly failed; we know now the reason for these failures.

Lobachevski succeeded in building a logical edifice as coherent as the geometry of Euclid, but in which the famous postulate is assumed false, and in which the sum of the angles of a triangle is always less than two right angles. Riemann devised another logical system, equally free from contradiction, in which this sum is on the other hand always greater than two right angles. These two geometries, that of Lobachevski and that of Riemann, are what are called the *non-Euclidean geometries.* The postulate of Euclid then can not be demonstrated; and this impossibility is as absolutely certain as any mathematical truth whatsoever. * * *

The first thing to do was to enumerate all the axioms of geometry. This was not so easy as one might suppose; there are the axioms which one sees and those which one does not see, which are introduced unconsciously and without being noticed.

Euclid himself, whom we suppose an impeccable logician, frequently applies axioms which he does not expressly state.

Is the list of Professor Hilbert final? We may take it to be so, for it seems to have been drawn up with care.

But just here this gives us a startling incident: the two greatest living mathematicians both in error. In my own class a young man under twenty, R. L. Moore, proved that of Hilbert's 'betweenness' assumptions, axioms of order, one of the five is redundant, and by a proof so simple and elegant as to be astonishing. Hilbert has since acknowledged this redundancy.

The same review touches another fundamental point as follows:

Hilbert's Fourth Book treats of the measurement of plane surfaces. If this measurement can be easily established without the aid of the principle of Archimedes, it is because two equivalent polygons can either be decomposed into triangles in such a way that the component triangles of the one and those of the other are equal each to each (so that, in other words, one polygon can be con-

verted into the other after the manner of the Chinese puzzle [by cutting it up and rearranging the pieces]), or else can be regarded as the difference of polygons capable of this mode of decomposition (this is really the same process, admitting not only positive triangles but also negative triangles).

But we must observe that an analogous state of affairs does not seem to exist in the case of two equivalent polyhedra, so that it becomes a question whether we can determine the volume of the pyramid, for example, without an appeal more or less disguised to the infinitesimal calculus. It is, then, not certain whether we could dispense with the axiom of Archimedes as easily in the measurement of volumes as in that of plane areas. Moreover, Professor Hilbert has not attempted it.

Max Dehn, a young man of twenty-one, in *Mathematische Annalen,* Band 55, proved that the treatment of equivalence by cutting into a finite number of parts congruent in pairs, can never be extended from two to three dimensions.

Poincaré's review first appeared in September, 1902. But on July 1, 1902, I had already presented, before this very section, a complete solution of the question or problem he proposes, the determination of volume without any appeal to the infinitesimal calculus, without any use of the axiom of Archimedes.

### 19. THE TEACHING OF GEOMETRY.

As Study has said: "Among conditions to a more profound understanding of even very elementary parts of the Euclidean geometry, the knowledge of the non-Euclidean geometry can not be dispensed with."

How shall we make this new creation, so fruitful already for the theory of knowledge, for kenlore, bear fruit for the teaching of geometry? What new ways are opened by this masterful explosion of pure genius, shattering the mirrors which had so dazzlingly protected from perception both the flaws and triumphs of the old Greek's marvelous, if artificial, construction?

One advance has been safely won and may be rested on. There should be a preliminary course of intuitive geometry which does not strive to be rigorously demonstrative, which emphasizes the sensuous rather than the rational, giving full scope for those new fads, the using of pads of squared paper, and the so-called laboratory methods so well adapted for the feeble-minded. Hailmann, in his preface, sums up 'the purpose throughout' in these significant words: 'And thus, *incidentally,* to stimulate genuine vital interest in the study of geometry.'

I remember Sylvester's smile when he told me he had never owned a mathematical or drawing instrument in his life.

His great twin brother, Cayley, speaks of space as 'the representation [creation] lying at the foundation of all external experience.' 'And these objects, points, lines, circles, etc., in the mathematical sense of the terms, have a likeness to, and are represented more or less imperfectly, and from a geometer's point of view, *no matter how imperfectly,* by corresponding physical points, lines, circles, etc.'

But geometry, always relied upon for training in the logic of science, for teaching what demonstration really is, must be made more worthy the world's faith. There is need of a text-book of rational geometry really rigorous, a book to give every clear-headed youth the benefit of his living after Bolyai and Hilbert.

### 20. THE NEW RATIONAL GEOMETRY.

The new system will begin with still simpler ideas than did the great Alexandrian, for example, the 'betweenness' assumptions; but can confound objectors by avoiding the old matters and methods which have been the chief points of objection and contest. For example, says Mr. Perry, 'I wasted much precious time of my life on the fifth book of Euclid.' Says

the great Cayley: 'There is hardly anything in mathematics more beautiful than his wondrous fifth book.'

For my own part, nothing ever better repaid study. But the contest is over, for now, at last, without sacrificing a whit of rigor, we are able to give the whole matter by an algebra as simple as if only approximate, like Euclid, including incommensurables without even mentioning them.

Again, we shall regain the pristine purity of Euclid in the matter of what Jules Andrade calls 'cette malheureuse et illogique definition' (Phillips and Fisher, §7): 'A straight line is a line which is the shortest path between any two of its points.'

As to this hopeless muddle, which has been condemned *ad nauseam*, notice that it is senseless without a definition for the length of a curve. Yet, Professor A. Lodge, in a discussion on reform, says: "I believe we could not do better than adopt some French text-book as our model. Also I., 24, 25, being obviously related to I., 4, are made to immediately follow it in such of the French books as define a straight line to be the shortest distance between two points." Professor Lodge, then, does not know that the French themselves have repudiated this nauseous pseudo-definition. Of it Laisant says (p. 223):

> This definition, almost unanimously abandoned, represents one of the most remarkable examples of the persistence with which an absurdity can propagate itself throughout the centuries.
>
> In the first place, the idea expressed is incomprehensible to beginners, since it presupposes the notion of the length of a curve; and further, it is a vicious circle, since the length of a curve can only be understood as the limit of a sum of rectilinear lengths; moreover, it is not a definition at all, since, on the contrary, it is a demonstrable proposition.

As to what a tremendous affair this proposition really is, consult Georg Hamel in *Mathematische Annalen* for this very year (p. 242), who employs to adequately express its content the refinements of the integral calculus and the modern theory of functions.

Moreover, underneath all this even is the assumption of the theorem, Euclid, I., 20: 'Any two sides of a triangle are together greater than the third side'; upon which proposition, which the Sophists said even donkeys knew, Hilbert has thrown brilliant new light in the *Proceedings of the London Mathematical Society*, 1902, pp. 50–68, where he creates a geometry in which the donkeys are mistaken, a geometry in which two sides of a triangle may be together *less* than the third side, exhibiting as a specific and definite example a right triangle in which the sum of the two sides is less than the hypothenuse.

Any respectably educated person knows that in general the length of a curve is defined by the aggregate formed by the lengths of a proper sequence of inscribed polygons.

The curve of itself has no length. This definition in ordinary cases creates for the curve a length; but in case the aggregate is not convergent, the curve is regarded as not rectifiable. It had no length, and even our creative definition has failed to endow it with length; so it has no length, and lengthless it must remain.

If, however, it can be shown that the lengths of these inscribed polygons form a convergent aggregate which is independent of the particular choice of the polygons of the sequence, the curve is rectifiable, its length being defined by the number given by the aggregate.

### 21. GEOMETRY WITHOUT ANY CONTINUITY ASSUMPTION.

Euclid in his very first proposition and again in I., 22, 'to make a triangle from given sides,' uses unannounced a contin-

uity assumption. But nearly the whole of Euclid can be obtained without any continuity assumption whatever, and this great part it is which forms the real domain of elementary geometry.

Continuity belongs, with limits and infinitesimals, in the Calculus.

Professor W. G. Alexejeff, of Dorpat, in 'Die Mathematik als Grundlage der Kritik wissenschaftlich-philosophischer Weltanschauung' (1903), shows how men of science have stultified themselves by ignorantly presupposing continuity. He calls that a higher standpoint which takes account of the individuality of the elements, and gives as examples of this discrete or discontinuous mathematics the beautiful enumerative geometry, the invariants of Sylvester and Cayley, and in chemistry the atomic-structure theory of Kekulé and the periodic system of the chemical elements by Mendelejev, to which two theories, both exclusively discrete in character, we may safely attribute almost entirely the present standpoint of the science.

Still more must discontinuity play the chief rôle in biology and sociology, dealing as they do with differing individuals, cells and persons. How desirable, then, that the new freedom should appear even as early as in elementary geometry.

After mathematicians all knew that number is in origin and basis entirely independent of measurement or measurable magnitude; after in fact the dominant trend of all pure mathematics was its arithmetization, weeding out as irrelevant any fundamental use of measurement or measurable quantity, there originated in Chicago from the urbane Professor Dewey (whom, in parenthesis, I must thank for his amiable courtesy throughout the article in the *Educational Review* which he devoted to my paper on the 'Teaching of Geometry'), the shocking tumble or reversal that the origin, basis and essence of number is measurement.

Many unfortunate teachers and professors of pedagogy ran after the new darkness, and even books were issued trying to teach how to use these dark lines in the spectrum for illuminating purposes.

There is a ludicrous element in the parody of all this just now in the domain of geometry.

After mathematicians all know of the wondrous fruit and outcome of the non-Euclidean geometry in removing all the difficulties of pure elementary geometry, there comes another philosopher, a Mr. Perry, who never having by any chance heard of all this, advises the cure of these troubles by the abolition of rational geometry.

Just as there was a Dewey movement so is there a Perry movement, and books on geometry written by persons who never read 'Alice in Wonderland' or its companion volume, 'Euclid and his Modern Rivals.'

But the spirits of Bolyai and Lobachevski smile on this well-meaning strenuosity, and whisper, 'It is something to know what proof is and what it is not; and where can this be better learned than in a science which has never had to take one footstep backward?'

GEORGE BRUCE HALSTED.
KENYON COLLEGE.

## THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

THE seventh regular annual meeting of this society was held, in conjunction with the meetings of several other scientific societies, at the University of Pennsylvania, Philadelphia, Pa., December 28–30, 1903. In the absence of the president and vice-president, the most recent past president, Dr. Erwin F. Smith, presided. Though not large in point of numbers the meeting

was in every respect one of the best in the society's history. The officers elected for the ensuing year were as follows:

*President*—Dr. G. T. Moore, of the Department of Agriculture, Washington.

*Vice-President*—Professor Clara E. Cummings, of Wellesley College.

*Secretary-Treasurer*—Professor W. F. Ganong, of Smith College.

The following new members were elected: Professor G. J. Peirce, of Leland Stanford University; Professor C. H. Shaw, of the Medico-Chirurgical College, Philadelphia; Dr. H. S. Conard, of the University of Pennsylvania. A committee, consisting of the new president, the secretary-treasurer and Professor D. S. Johnson, was appointed to confer with similar committees from the other botanical societies upon possible future affiliation or union of botanical societies.

The social features of the meeting were very enjoyable. They included a reception to the society by the Botanical Society of Pennsylvania and the Graduate Botanical Club of the university, in Biological Hall, Monday evening, December 28, luncheon tendered to the members of all the societies by the university on Tuesday and Wednesday, December 29 and 30, the smoker given by the local committee to all the visiting scientific men on Tuesday evening, December 29, the reception to the members of all the scientific societies by Dr. and Mrs. Horace Jayne on Wednesday evening, December 30, and many courtesies extended to the visiting members by members of the society resident in Philadelphia. On Wednesday afternoon the members of the society visited and were shown the Philadelphia Museums, on the special invitation of the director, Dr. W. P. Wilson, and later they visited Horticultural Hall.

The papers, of which abstracts follow, were all presented in full and discussed by the society, and they include every paper which appeared upon the program. The abstracts are in every case by the author of the paper.

*Experimental Morphological Investigations on the Abietineæ* (illustrated by photomicrographic stereopticon slides): Professor E. C. Jeffrey, Harvard University.

The intention of the present communication is to show that experimental investigation is useful in determining the most primitive type of wood in the Abietineæ, a matter of considerable importance from the standpoint of the phylogeny of the Coniferales, since the identification of fossil species in this group rests at present very largely on the study of fossil woods. Among the existing genera of Abietineæ, *Pinus, Picea, Larix* and *Pseudotsuga* are characterized by the presence of resin-canals in their woody tissues, while *Cedrus, Abies, Pseudolarix* and *Tsuga* are without ligneous resin-ducts. The question arises, which of these two types of wood is the more primitive, and this question the author has attempted to settle from the experimental and comparative anatomical standpoints.

*Abies* may be taken as an example of a genus without ligneous resin-canals. In *Abies balsamea* resin-ducts appear in the wood as a result of mechanical injury and also as a result of the attack of parasitic fungi, producing 'witches' brooms.' In this and (all?) other species of *Abies* resin-canals are also normally present in the primary wood of the root. In certain species of *Abies* investigated in this connection, resin-canals are found not only under the conditions described for *Abies balsamea,* but also in *the woody axis of the female cone and in the first annual ring of vigorous shoots.* The two last-mentioned modes of occurrence of resin-canals are of special interest, for they must be regarded as

ancestral. It is now a well-established generalization that palingenetic features of anatomical structure are apt to persist in reproductive axes, and consequently the occurrence of ligneous resin-canals in the cones of certain species of *Abies* is good evidence that resin-canals were once a general feature of the wood in the ancestral species of the genus. This conclusion is strongly supported by the presence of resin-ducts in the *first annual ring only* of vigorous branches in certain species of the genus under consideration, for in this instance we have to do with the phenomenon of recapitulation, so well exemplified in seedlings of plants and in the young of animals. The conclusion is accordingly drawn, from both comparative anatomical and experimental data, that the genus *Abies* has come from ancestors possessing ligneous resin-ducts. Similar data in the case of the other genera usually described as lacking ligneous resin-canals, viz., *Cedrus, Pseudolarix* and *Tsuga,* lead to the same conclusion, that is, that these too have come from ancestry possessing ligneous resin-canals. As a further consequence of these observations the generalization is made that the older type of wood in the Abietineæ, is that in which resin-canals are present. The full significance of this generalization does not appear at the present time, but will be made clear as the remaining families of the Coniferales are described, from both the morphological and the anatomical standpoints.

*Vegetative Reproduction in Certain Epiphyllous Lejeuneæ:* Professor A. W. EVANS, Yale University.

The circular or oblong discoid gemmæ found in *Lejeunea convexistipa, L. accedens* and an allied new species were described. Each consists of a single layer of cells and is attached by its margin to a single projecting leaf-cell. Similar gemmæ have been described for the genus *Radula* and also for other Lejeuneæ, but all of these differ in various points of detail. In the two Lejeuneæ referred to the gemmæ are shaped like a watch-glass and become inverted before germination takes place, in this way turning their concave faces toward the substratum. In the flat gemmæ of the undescribed species no such inversion seems to be necessary. In *L. convexistipa* the gemma retains its apical cell and upon germination gives rise directly to a leafy shoot. In *L. accedens* the gemma does not retain its apical cell and upon germination produces a flat protonema, from which the leafy shoot develops later. In the undescribed species both types of germination occur. This last plant is further remarkable because the protonema sometimes gives rise to secondary gemmæ, similar in all respects to those developed on the leaves. In this respect it resembles the peculiar genus *Metzgeriopsis,* of Java, in which the long-lived protonema bears both discoid gemmæ and leafy shoots.

*Additional Notes on the Structure of the Starch Grain:* Dr. HENRY KRAEMER, Philadelphia College of Pharmacy.

The author has continued his work on the study of the starch grain, and presented evidence to show (1) That the peripherical layer of the starch grain is a distinct membrane; (2) that soluble starch is present in the unaltered grain; (3) that iodine forms a definite, but easily dissociated, compound with starch; and (4) he gave a method for staining wheat starch grains. This method is as follows: To 0.500 gm. of starch add 2 c.c. of an aqueous iodine solution (containing 0.1 per cent. of iodine and 0.5 per cent. of potassium iodide); allow the mixture to stand 20 minutes, and then add 2 c.c. of a saturated aqueous solution of gentian violet; allow this mixture to stand from 12 to 24 hours, examining mounts of the material from time to time; when the grains

are satisfactorily stained, the mixture is transferred to a filter and the excess of stain is removed as quickly as possible by washing the magma with water; the material is then allowed to dry spontaneously, and mounted in Canada balsam, both the preparations and the dried material being permanent.

The foregoing method has features similar to the method used for demonstrating the so-called continuity of protoplasm in the vegetable cell-wall, and those who are interested in the latter subject will do well to compare their preparations with those of the wheat starch grain, made by the method just described.

*On an Undescribed Thermometric Movement in the Branches of Woody Plants:* Professor W. F. GANONG, Smith College.

Some years ago the author observed a definite radial or in-and-out movement of the ascending branches of certain shrubs in winter, and undertook a systematic study of the movement, which appears not to have been investigated hitherto. By means of accurate measurements made with steel tapes from a central permanent tripod, the exact amount of the movement was determined for several shrubs and small trees. The results, when plotted, not only showed the movement to be real and of considerable amount, but also proved that the inward movement increases steadily after leaf fall till past midwinter, when an outward movement commences, long before the weight of the leaves begins to be felt. Furthermore, the important fact was discovered that the movement shows remarkable in-and-out secondary fluctuations, which are closely correlated with temperature changes. Experiments undertaken to determine the physical basis of the movement eliminated one possible cause after another until it was determined that it was correlated with the percentage of water in the stems, this rising with a higher and falling with a lower temperature. It was proved that the weight of this water was insufficient to cause the entire movement though it does influence it, and evidence was given to show that the movement is probably due to the swelling of the parenchyma cells of cortex and pith under the osmotic absorption of the water permitted by the increased supply conducted up the stems in the periods of warmer weather. This swelling of the cells causes a straightening of the branch and hence the outward movement. The movement appears, therefore, to have no ecological significance but to be simply the incidental result of the physical and mechanical construction of the stems, but it is a new and interesting phenomenon. As it is an incidental result of, and closely dependent upon, temperature changes, the author has named the movement thermometric.

*The Olive Tubercle* (illustrated by stereopticon photographs and inoculated specimens): DR. ERWIN F. SMITH and MR. JAMES B. RORER, Department of Agriculture.

This disease was taken up because its bacterial origin has recently been called in question by Dr. Fischer. After describing the disease, which has been known for many centuries in Europe and has recently done much damage in California olive orchards, the experiments of Savastano and others were outlined, and then those undertaken in Washington. Tubercles were obtained from California. No difficulty was experienced in plating out bacteria or in finding them in the tissues on microscopical examination. They occurred abundantly in small irregular pockets. No fungi were present. From small knots pure cultures of a white bacterium were plated out, and with this organism the knots were reproduced. The olive trees used were small

ones propagated from older trees which have been in a hothouse of the U. S. Department of Agriculture for many years and which have always been free from this disease. The inoculations were made into young growing tissues (shoots) by needle pricks, using subcultures made from single colonies. In this way, using the right organism, knots have been produced on about fifty plants—in fact, on every one inoculated. The tumors began to appear within a few weeks and were well developed in two months. From these artificially produced knots, pure cultures of the original organism have been plated out in quantity a number of times, and have also been demonstrated *in situ* both stained and unstained. Young knots are also now developing on shoots recently inoculated with the organism plated out of the artificially induced knots. An equal number of check punctures made into the same plants, in shoots of the same age, healed promptly and did not develop any tumors. During the seven months covered by these experiments only one accidental infection has occurred. This recently discovered knot appeared on an inoculated shoot about fifteen inches below the punctures (where a tumor also developed), and the infection appears to have entered through a leaf scar. Old tumors may contain other bacteria, but these when inoculated do not produce the disease. The experiments fully confirm Savastano's statements respecting the bacterial origin of this tumor, but the parasite appears to be a white rather than a yellow organism. The knot is an enormous hyperplasia, the exciting influence of the bacteria extending far beyond their actual presence. Various tissues are involved in the tumor and they are much changed. A special paper will be devoted to this feature of the subject.

*Bacterial Leaf Spot Diseases* (illustrated by numerous stereopticon photographs): Dr. ERWIN F. SMITH, Department of Agriculture.

This paper was presented principally to call renewed attention to the fact that bacterial infection of plants through the ordinary stomata is not at all infrequent. Much remains to be done on these spot diseases, but a careful study of serial sections made through very young stages of spots occurring on several different plants show the epidermis unbroken and the enclosed bacterial masses lying in such relation to the stomata as at once to suggest such infection. No other avenue of infection is open. The plum leaf spot and the angular leaf spot of cotton have been studied within the year, particularly with reference to this mode of infection. In case of the spot disease of the larkspur, pure cultures of the bacterium have been plated out of the spots and the disease reproduced in blue hybrid *Delphiniums* and also in *D. ajacis* within a few weeks' time by simply putting pure cultures into sterile water and spraying this on the plants. The result of this disease is numerous sunken black spots on leaves and stems, with more or less distortion. The inoculations were made in Washington, some in the hothouse, others in a garden. The disease is known to occur naturally only in Massachusetts. The organism is motile, gray-white, nitrate-reducing, non-liquefying, and on agar in early stages the small circular surface colonies have a wrinkled structure easily demonstrated by magnification of twelve. It grows well at 30° C. but not at all at 37.5°. Its thermal death point is over 48° and below 49.10° C. It grows well in Uschinsky's solution. In agar the buried colonies are small. For this organism the name of *Bacillus delphini* is suggested. The other bacterial spot diseases mentioned as having come to the writer's

attention within the last two years were those of *Pelargonium,* soy bean, cow pea and ginseng. The latter is rather a yellowing and fraying of the leaf margins than a true spot. From the extremely numerous and quite characteristic spots on the soy bean leaves a yellow bacterium was isolated. This disease has been observed only in the vicinity of Washington.

*A Fungus Infesting Stored Sugar:* Dr. C. O. Townsend, Department of Agriculture.

The attention of the writer was called last summer to the abnormal condition of a quantity of granulated sugar stored in barrels. The sugar had become damp and unsalable, and could be restored permanently to its normal condition only by remelting and reworking. It was at first thought that this peculiar condition of the sugar was due to the presence of hygroscopic salts, but a careful examination showed that the sugar was practically free from salts of any kind. Upon placing a small quantity of the abnormal material under the microscope, numerous fungous threads and many round bodies resembling fungous spores were observed. When the material was plated out, three distinct fungi were found and pure cultures of each were made. As soon as these produced spores, quantities of normal sugar were inoculated and placed in damp chambers. In from two to three weeks the cultures made from one kind of spores—a *Penicillium*—showed the same characteristics that had been observed in the stored sugar, the cultures from the other fungi remaining unchanged for an indefinite period. It was found that the *Penicillium* spores would germinate and that the fungus would grow readily on sugar solutions of all strengths up to and including a fifty per cent. solution, and even on a saturated solution the spores germinated and produced new spores in from six to eight days. The fungus grows readily on pure dextrose solutions, on solutions of C. P. maltose, and on all kinds of cooked vegetables, but it does not grow readily upon raw vegetables. The infested sugar becomes inverted, as shown by Fehling's test and by the fact that the polarization is reduced in all cases. Sometimes the reduction is as much as 99.8 to 92. The trouble may be prevented by storing the sugar in dry, well-seasoned barrels and keeping in a dry place.

*Observations on the Structure of Dischidia, a Climbing Epiphyte from the Philippines:* Dr. John W. Harshberger, University of Pennsylvania.

*Dischidia* sp. is a twining epiphyte native to the open areas in the province of Zambales, P. I. The plant, which early severs its connection with the soil, lives attached by horizontally placed adventitious roots to the surface of dead bamboo canes. It has two forms of leaves. The foliage leaves are thick and fleshy. The others are pitcher-shaped and about an inch and a half long. A second kind of adventitious root develops and grows into the pitchers, where it branches and forms an interlacing mass closely applied to the lower, inner surface of the saccate leaves. Inside the outer pitcher, a smaller one is developed, which represents the incurved apex of the highly modified leaf. A small black ant frequents the outer pitchers and carries into them decaying wood and leaf mold, from which the roots in the pitcher derive a constant supply of plant food. The details of the structure have been elaborated by Treub, Groom, Scott and Sargant for *Dischidia rafflesiana,* but the plant from the Philippines differs from this species in the following points: (1) The presence of long adventitious roots, which penetrate the pockets of decaying matter, collecting where a circle of bamboo branches arise; (2) the development of a

second pitcher within the outer one; (3) the shape of the outer pitcher, which is broader than long, and (4) the growth of the plant on dead bamboos instead of dead trees, as with *D. rafflesiana*. The presence of a purple color on the under surface of the pitcher the speaker believed to be correlated with the growth of the roots on that side and is not, as Groom claims, to shade the roots from too intense light. The absence of dead or partially digested ants would exclude the possibility of the pitchers being insect traps. In all probability they serve as chambers where water in the aqueous or gaseous state collects, and for the collection of humus upon which this asclepiadaceous plant primarily depends for food.

*On the Excretion of Hygroscopic Salts in Frankenia and Statice:* Mr. T. H. KEARNEY, United States Department of Agriculture.

Certain plants of arid regions, notably members of the Tamaricaceæ, Frankeniaceæ and Plumbaginaceæ, have long been known to possess the property of excreting salts in solution by means of epidermal glands of highly specialized structure. The excreted salts, in the cases recorded, are strongly hygroscopic. During the daytime when evaporation is intense, they exist as a dry granular deposit or as a thin continuous coating on the surface of the plant, while during the night they take up water. In the early morning the leaves and stems are often covered with drops of solution.

Observations were made upon *Frankenia grandifolia* in California and *Statice limónium* var. *Californica* in western Texas, both plants occurring in moist, strongly saline soils. In both cases chemical analysis showed that the principal constituents of the excretion were also the principal soluble constituents of the soil in which the plants were growing, although the proportions differed sufficiently to indicate selective power on the part of the plant. In *Frankenia*, sodium and hydrochloric acid were the principal constituents of the excretion, while in *Statice*, calcium and sulphuric acid predominated. That the glands function actively in the process of excretion was demonstrated by brushing over portions of the leaf surface in living plants with an alcoholic solution of mercuric chloride. Areas thus treated nearly or quite ceased to excrete, while unpoisoned areas of the same leaf continued to excrete vigorously. Hence the 'salt glands' evidently belong to that type of hydathodes or water-excreting organs in which an active glandular function is involved.

What is the significance to the plant of this excretion of salts? Volkens, on the basis of a simple experiment performed upon *Reaumuria hirtella* near Cairo, concluded that the glands are able to take up water from the strong salt solution with which the surface of the plant is covered in the night and early morning, and thus supplement the roots as absorbing organs. Marloth and Haberlandt, however, have shown that Volkens's experiment does not necessarily prove more than a reduction of transpiration effected by the presence of the salt excretion.

A series of experiments upon *Statice* by the writer demonstrated that the absorbing power of the uninjured surface of the living leaves, even when immersed in pure water, is very small. Furthermore, concentrated salt solutions, applied either by immersing the leaf in them with the cut surface protected from contact with the solution or by placing a small amount of powdered calcium chloride on leaves kept in a saturated atmosphere, so far from giving up water to the leaves, actually withdrew a large amount from them, although not causing plasmolysis under these conditions. Addition of coloring matter to salt

solutions and to pure water in which leaves were immersed showed only a very slight penetration of the stain into the glands and other epidermis cells, and none into deeper-lying tissue. Incidentally, the gland cells were found to be much more resistant to plasmolysis than are other cells of the leaf.

Hence it is reasonably certain that in the case of *Statice*, at least, the epidermal glands are not absorbing, but merely excreting organs. Their importance to the plant may consist in their enabling it to rid itself of excessive amounts of salt, while secondarily the presence of the salt deposit on the plant is, perhaps, useful in reducing the rate of transpiration from its surface. The question whether under natural conditions the leaf is able to withstand the attraction exerted upon its water content by the solution tension of the excreted salts, remains unanswered.

*The Cardinal Principles of Ecology:* Professor W. F. Ganong, Smith College.

The paper comments upon the rise and promise of ecology, points out certain marked defects in its present methods, and discusses the direction it must take in order really to advance in the future. The ecology of the future must be based upon the exact study of environmental physics in correlation with physiological life histories of plants. Then the principles underlying the nature of adaptation are discussed, including the reality of adaptation, its evolutionary origin, its race (not individual) character, the necessary imperfection of all adaptation, its metamorphic phylogeny. This paper is to be published in full in Science.

*Cinchona in Jamaica as a Botanical Station* (illustrated by stereopticon photographs): Professor D. S. Johnson, Johns Hopkins University.

Cinchona Station, recently visited by the speaker, is located on a spur running southward from the Blue Mountain chain. It is 4,900 feet above sea-level and has a climate that is comparatively dry, cool and stimulating. On the plantation at present are a well-built residence, several buildings fit for laboratories, a greenhouse and a rather extensive garden. The latter contains many introduced alpine and temperate-climate plants from many parts of the globe. On the remaining 20,000 acres of the plantation, and in the surrounding regions, are to be found many types of vegetation, varying from the dense forest of the mountains and of the deep river valleys, through many types to the xerophytic vegetation of the hills and plains south of the Blue Mountains.

The rich and varied flora, delightful climate, equipment and ready accessibility from all the Atlantic ports of the United States, make together a series of advantages such as probably no other location in tropical America possesses.

*The Influence of Differences in the Electrical Potential on the Growth of Plants:* Professor G. E. Stone and Mr. N. F. Monahan, Massachusetts Agricultural College.

For many years the idea has prevailed that atmospheric electricity exerts an influence upon plant growth. It is known that vegetation frequently becomes charged with electricity to quite an extent, also that during thunder-storms the potential of the air is likely to be high, and frequently changes from positive to negative.

Observations made in our laboratory have shown that at a distance of thirty feet from the ground the air is charged positively about 90 per cent. of the time. The differences in potential between the earth and the air ranged in voltage from 75 negative to 300 positive. Some of the earlier experiments, carried on in a limited way, seemed to show that when atmospheric

electricity was withdrawn from a plant growth was retarded. These earlier experiments were conducted by surrounding plants with wire cages, thus screening them, as it were, from atmospheric electricity. A series of experiments were made for the purpose of ascertaining whether any relationship existed between the growth of outdoor plants and the differences in atmospheric electrical potential as obtained by frequent measurements of the plants, and by the aid of a Thompson self-recording electrometer. These experiments were not, however, for various reasons, very satisfactory.

Subsequent experiments were, therefore, conducted in a large glass case which was charged to various potentials, and for this purpose potted tomato plants, about three inches high, corn seedlings and molds, such as *Mucor* and *Phycomyces,* were employed. Potentials varying from 100 to 2,000 volts were made use of; the latter appeared to act disastrously in many cases. Small tomato plants responded most favorably under a potential of about 50 volts, which is not far from the optimum for tomato plants of this size. *Mucor* and *Phycomyces* responded most favorably to lower potentials, and the effects of high potentials were particularly disastrous to them. The latent period had a duration of from fifteen to twenty-five minutes.

The experiments with various seeds showed that germination was greatly accelerated, although in the case of old seeds there was no evidence that electrical stimulation resuscitated life.

The most essential facts brought out were that there exists a minimum, optimum and maximum potential corresponding with the nature, size and degree of development of the plants, and that when plants are grown under conditions in which the influence of atmospheric electricity is eliminated, they exhibit a marked response to electrical stimuli. The potential which induced this response is within the range of that usually found in nature. There is every reason to believe that electricity acts as a stimulus to plants in nature, and undoubtedly has much to do with their development and configuration.

*The Effect of the Presence of Insoluble Substances on the Toxic Action of Poisons:* DR. RODNEY H. TRUE and MR. C. S. OGLEVEE, Department of Agriculture.

During the summer of 1903, at the Marine Biological Laboratory at Woods Hole, Mass., the authors undertook a study of the effect of insoluble substances on the poisonous action of solutions of electrolytes and non-electrolytes. A modifying action has been observed by Nägeli in the case of algæ, and it is a common observation that poisonous solutions applied to said cultures are not as effective as in even more dilute water cultures. In the experiments here summarized, mercuric chlorid, silver nitrate and copper sulphate have received attention as representative electrolytes; and phenol, resorcinol and thymol as representative non-electrolytes. Carefully prepared sand, filter paper and paraffine were used as insoluble bodies. The test reaction was the growth rate of the primary root of *Lupinus albus* seedlings, made during a period of twenty-four hours of exposure to the solutions in question. The toxic substances were made up in strong stock solutions which in these experiments were diluted to concentrations sufficiently toxic to exert a marked effect on the growth of the plants. In the case of the heavy metals above mentioned, a decided acceleration in growth was seen to accompany the presence of the insoluble substances in the solution. No such acceleration followed the introduction of the insoluble substances into the check cul-

tures in distilled water, nor did any marked result appear.

In the case of the copper sulphate solutions, the action of the insoluble bodies seemed to be especially well marked. In many instances the introduction of 40 grms. of sand into 150 c.c. of a given solution was seen to accelerate the growth rate from a few millimeters in the check solution containing the copper salt alone to a growth rate nearly normal for the distilled water used in making the solutions. The modifying action of the insoluble substances was found to vary widely, according to the quantity used, assuming that the volume and concentration of the solution are constant. The following instance is typical:

| | | | |
|---|---|---|---|
| 35,000 liters solution. | | 2.0 | mm. |
| " | + 40 grms. sand. | 7.0 | " |
| " | + 80 " " | 10.0 | " |
| " | + 120 " " | 16.0 | " |
| " | + 160 " " | 13.0 | " |
| " | + 200 " " | 12.0 | " |
| Distilled water. | | 12.0 | " |

In this case growth was practically at a standstill in the copper solution. The introduction of 40 grms. of sand gave a growth rate equal to one half of the growth rate in distilled water. The addition of further sand resulted in a growth rate of increasing rapidity, until when 120 grms. were added a maximum was reached. Further addition of sand was followed by a decreased rate of growth, finally approximating that of the check.

Unpublished investigations were cited in which it was shown that a somewhat similar situation results when a series of progressively diluted solutions of the copper sulphate is tested by the above method with the lupine radicles. In concentrations of toxic activity, growth is quickly suppressed. As the solution is diluted more and more, the growth rate increases, until a rate characteristic of distilled water is reached. In the action of the copper sulphate solution the phase characterized by the depressed growth rate may be termed the depression phase. This is succeeded, at a given concentration, by a growth rate like that of the check, the copper being neutral in its action. Upon further dilution the radicles are found to grow more and more rapidly until at a definite concentration a maximum rate is reached, which much exceeds that of the check. Further dilution at this point is followed by a falling off in the rate of growth until at a definite concentration the solution is so weak in its action as to leave the medium equivalent to so much distilled water. The first neutral phase is thus seen to be followed by a phase of pronounced acceleration of growth rate. This acceleration rises to a maximum and declines to a second neutral phase of indefinite extent covering all greater dilutions.

From these experiments it seems clear that the presence of insoluble substances exerts an effect closely paralleling that of simple dilution. By comparison with the growth curve obtained in increasingly diluted solutions, it is possible to indicate what amount of copper remains in the free solution unremoved, physiologically speaking, by the solid.

Various investigators have shown that gases are condensed over surfaces of solid bodies, the layer of gas in contact with them containing a much greater concentration of molecules than is contained by a like volume of free space. This has been extended to solutions. It has been shown that the walls of the containing vessels or solid particles placed in the solutions condense substances from aqueous solutions. It has been found that this process, known as adsorption, is largely dependent upon the nature of the adsorbing solid and on the amount of surface it offers to the solution. The adsorptive activity of sand, filter paper, charcoal and other bodies has been demonstrated. These bodies are all

wetted by the solution from which molecules are adsorbed. In the investigations here reported, not only were solids used which were wetted by the aqueous solution, but also paraffine, in the case of which a different type of contact exists between the solid and the solution. Perhaps no contact exists in the sense of a relation so intimate as to bring the molecules of the dissolved substance into actual contact with the paraffine. The contact surface between the paraffine and aqueous solution may, perhaps, be regarded as comparable to a surface film which bounds the contact of the solution with air. Whether or not an actual air film is present between the paraffine and aqueous solution, the presence of paraffine in solutions of the toxic agents was seen to exert a marked effect, perhaps as great as that of sand. It is probable, therefore, that the generalization of the physical chemists concerning adsorption may be extended so as to include among adsorbing surfaces those films which in solutions surround bodies which are not moistened by the solution. Physical investigations on this point are lacking.

It is regarded by the authors as probable that the insoluble substances used in experiments here summarized act as adsorbing surfaces for molecules or ions of the poisonous substances used, the number of molecules or ions thus adsorbed being, at the extreme dilution here cited, sufficient to remove a very considerable proportion of the ions or molecules from the free solution. These are considered as collected over the surfaces of the insoluble substances or films present in the solutions in a layer molecularly much denser than the free solution. In bringing about this redistribution of molecules or ions, the free solution, when equilibrium has been established, is necessarily much weakened in ions or molecules. This affects the solution much like the addition of water, bringing about a decreased number of molecules in a given volume of the free solution. Hence the close parallel seen between the conduct of the radicles in solutions containing increasing quantities of insoluble substances and in progressively diluted aqueous solutions.

Concerning the relation of the poisonous substance to the adsorbing surfaces, a further point is developed. In the solutions of the heavy metals already referred to, complete ionization is probable, and a possible electrical relation might be supposed to exist. This is, however, not necessarily so, since in solutions of thymol, a non-electrolyte, a similar action was seen, indicating that the electrical conditions in the solution play no necessarily important part.

The bearings of this work on practical problems of plant physiology are very many. It is impossible to argue from the behavior of plants in water cultures to their behavior in soil, since in the soil adsorption is seen in a high degree of efficiency, where films and insoluble substances bring about a situation entirely different from that seen in a free solution. Hygroscopic water, so called in works on plant physiology, is doubtless to be regarded as an adsorbed solution governed by the laws of adsorption. The recognition of this relation would render physiological discussions bearing on soil conditions much clearer. The stock experiments in elementary plant physiology demonstrating that solutions poured from clean sand come out weaker in molecules than they go in, is to be explained as an example of *adsorption* rather than *absorption* by the soil. The importance of adsorption physiologically with reference to the root system, especially the root hairs, is seen when one bears in mind the fact that in the ground water those portions of the solutions are richest in molecules which are adjacent to insoluble substances or films. Many relations of a plant to its substratum are affected by this con-

dition of affairs which can not be pointed out here.

In the interior of the plant, with the large amount of wall surface, and, in case of storage cells, of solids like starch grains, etc., adsorption may also play a considerable rôle. It seems probable that in addition to osmosis and diffusion the distribution of dissolved materials in the plant may be very largely affected by adsorption. It seems probable that this form in which energy is exerted may play a part of unsuspected importance in the plant. Not the least important, perhaps, may be the effect of adsorbing surfaces in bringing about at points of greatest activity an increased concentration of the raw materials needed in connection with these processes.

The efficiency of bacteria as adsorbing bodies is probably great and the physiological activity of minute organisms may be in part due to the energy of adsorption, which brings about a concentration of the medium at the surfaces of the organisms, making possible the characteristically active metabolism even in dilute media. Further experiments along the various lines here indicated are in progress.

*An Exhibition of Several New Precision Appliances for Investigation and Demonstration in Plant Physiology:* Professor W. F. GANONG, Smith College.

It was pointed out that the development of makeshift or improvised apparatus for plant physiology has gone as far as practically possible, and farther than is educationally and scientifically desirable, and that the next movement in this subject should be towards the development of normal apparatus, pieces which will be manufactured for the specific work to be done or topic to be studied, which will perform that work with accuracy and with convenience and economy of time in manipulation, and which will be obtainable from the supply companies precisely as physical and chemical appliances are. Several new pieces, which have been invented by the exhibitor, were then exhibited. They are to be manufactured and offered for sale under his supervision by the Bausch & Lomb Optical Co. The pieces exhibited included (1) a new clinostat, very compact, capable of working in any position whatsoever, powerful enough to carry a five- or six-inch pot in any position, needing winding but once in two days; (2) a new portable clampstand for apparatus, with handles for carrying it about, levelling screws, special positions for the rods, and new special clamps; (3) an autographic transpirometer, which can be used with any balance sensitive to a gram, and which records precisely on a drum the transpiration of a plant for a week; (4) a new photosynthometer, by which the exchange of gases in photosynthesis may be exactly and conveniently measured, either for demonstration of the processes to classes, or in investigation for particular plants; (5) a new leaf clasp chamber for use wherever it is desired to apply patterns, cobalt chloride paper or other object exactly matching upon the two faces of the leaf; (6) a new leaf chamber for holding a leaf under approximately normal conditions perfectly flat in any desired position while studying various phases of photosynthesis, etc. The apparatus is all mechanically unexceptionable, and it was announced that other pieces are in preparation and more or less advanced towards completion.

*On the Spores of Certain Coniferæ:* Professor W. C. COKER, University of North Carolina.

It has been long known that the mature pollen grain of a number of conifers contains no sterile prothallial cell. The possibility still remained, however, that one or more such cells might be cut off early in

development and, by complete absorption, leave no trace in the fully mature grain. For the determination of this point the following forms were examined: *Cupressus* (four species), *Taxus baccata* and four varieties, *Juniperus* (two species), *Chamæcyparis* (five species), *Callitris* (one species), *Cryptomeria japonica, Thuja orientalis.*

The results showed that in all these forms there was no prothallial cell formed at any time in the development of the pollen. Ovules of *Thuja orientalis* and *Taxus baccata* were examined to determine the number of potential megaspores formed. It was found that in *Taxus* there are four produced—these lying, as a rule, in a row, and the lower developing into the prothallium.

In *Thuja* there are also four magaspores produced, but they are arranged, not in a row, but in nearly regular tetrad form, differing in this respect from all other gymnosperms so far studied.

W. F. Ganong,
*Secretary.*

Smith College,
Northampton, Mass.

## SCIENTIFIC BOOKS.

### STILL ANOTHER MEMOIR ON PALÆOSPONDYLUS.

*Palæospondylus*, like Gloster, seems to have been born to bite the world—for in its few short years of morphological nurture it has succeeded in causing trouble to an amazing degree. And we venture to use an Elizabethan simile with a clearer conscience, since in the latest time we are told that this obscure little fossil is not to be looked upon as a toothless lamprey, but rather as a shark. We must none the less admit that it gives us a sense of sadness to learn of the new rôle of the fish, since this reduces by one the novelty of its being assigned to still other groups, for we recall that the number of groups is well nigh exhausted. There remains in fact but one more of the major groups of aquatic vertebrates to which it can possibly be assigned. It has already been reckoned among arthrodires (? ostracophores), lampreys, teleostomes (*Allis*), sharks, lung-fishes, even amphibians. To make our list complete, we have now only to assign it to holocephals. And lest some one anticipate us, we may as well regard it as a chimæroid at this time, and in evidence of this refer to its continuous dorsal fin, 'protocercal' tail, ring vertebræ, elaborate nasal cartilages, huge head—and we might find other similarities if we tried hard enough. Seriously, though, such a state of affairs is a reproach to modern morphology, that with all our extensive knowledge of fishes we are not able to come to a better understanding of our Devonian 'lamprey.' For if the remains of *Palæospondylus* are so poorly preserved that they cannot be definitely described, why do we continue to add papers to the troublesome literature? The only possible excuse is that the creature is seductive, full of suggestions as to the origin of the gnathostomes, and the mode of evolution of jawless vertebrates.

During the past summer I happened to see in South Kensington some of the elaborate models of *Palæospondylus* which Professor Sollas and Ingerna B. J. Sollas have been preparing. These are built up of thin wax plates, after the method of Born, the sections, however, having been outlined at a series of levels (differing in thickness for about .1 +, .025 mm.) as the fossil was carefully ground down. And I examined the models with great interest, wondering whether by a new method there could be gained facts which would help to solve the present puzzle.

In their complete paper* the authors now discuss the results obtained from a series of their models, of which no less than eight have been prepared. They describe the characteristic parts of the fossil, christening some of them with rather difficult names such as 'hemidome,' 'tauidion,' 'ampyx,' 'gammation' and 'pre-gammation.' But the structures described which interest us especially are the 'branchial arches,' four in number, showing

* 'An Account of the Devonian Fish, *Palæospondylus gunni*, Traquair,' by W. J. Sollas and Ingerna B. J. Sollas, *Phil. Trans.*, Series B, Vol. 196, pp. 267–294, pls. 16 and 17.

both 'epi-' and 'basi-' and 'cerato-branchial' divisions, and the 'quasi-maxillary' cartilage. For if these structures are present, our knowledge of *Palæospondylus* has made a forward step and an important one. For it excludes one hypothesis, that of a Devonian lamprey. I confess, however, much as I am in sympathy with this result, that a critical examination of the present plates does not convince me that the authors have carried their point. When one bears in mind the fact that the head region of the tiny fossil is flattened out of reason, bitumenized, with parts displaced, with irregular contours now separate, now confluent, it is difficult to see, for example, why the 'maxillaries' should be anything more than the rim of the 'hemidome' (cf. Figs. 10, 11, 12), or the most conspicuous 'gill arches' more than the anterior and posterior rims of the 'otic' mass. And there is in fact variation enough in these elements, even in the figures given, to warrant our skepticism. Indeed, if one has still any faith in the preservation of intricate interrelationships of delicate elements in *Palæospondylus*, he has only, I believe, to consider the shapeless condition of the neighboring vertebral column and fin supports as shown in any of the models, for we are morally sure that centra and fin rays never existed in the living animal in such an amorphous mass as here represented.

Grateful we certainly are to these painstaking authors, for the facts they present are desirable, even though we may be disappointed in their content. But the chiefest virtue of their research is to my mind this—that by the micro-section method we can add little of importance to our knowledge of this form. For in spite of such a method, and admirably carried out, no certain details have been added to those already detected in the usual way by the keen eye of Dr. Traquair. And if this is true one need hardly add that what is especially needed in our future dealings with *Palæospondylus* is less memoir and more material. In this regard I can not repress the belief that the paleontologist who will spend some time, possibly months, in the little quarry at Achanarras will yet solve the puzzle. There is certainly evidence that although five out of ten of the fossils measure between 20 and 30 mm. some certainly occur which are over 50 mm. in length, and that between the largest and the smallest there are gradations in the proportions of head and column both in length and thickness. And if this be true, why may not *Palæospondylus* prove a larval form, and in this event more abundant material might reasonably prove what the adult is? The latest authors 'far from deny that some change in the proportional size of the organs of *Palæospondylus* has taken place with growth,' but I think they would have been more impressed had they examined better preserved specimens, and those especially with a greater range in size. Their smallest specimen probably measured little under 18 mm., for it measured 14 mm. and lacked obviously the tail tip. On the latest evidence, therefore, we can hardly deny the possibility that *Palæospondylus* was a larval form. Bashford Dean.

Columbia University.

*Catalogue of Keyboard Musical Instruments in the Crosby Brown Collection*, 1903. The Metropolitan Museum of Art. New York. 4to. Pp. 313. Price, $1.00; express, 25 cents.

In continuation of the series of catalogues already noticed in Science (N. S., XV., p. 943, 1902) the present sumptuous volume has recently been published.

In 127 half-tone plates made from photographs from the originals, 84 keyboard instruments are shown. No such collection of instruments is found elsewhere in the world, and no such collection of illustrations is available in any other book, or dozen books. There are 43 plates of 24 plucked instruments—psaltery, spinet and harpsichord; 47 plates of the 32 instruments with struck strings—dulcimer, clavichord and piano; 2 plates of bowed instruments; 28 plates of the 21 keyboard wind instruments—regals and organs; and 7 plates of 5 pianos with metal or glass bars; then follow 7 plates illustrating actions. Many of them are full-page plates. There is a brief description of each instrument, and the late A. J. Hipkins (remembered by physicists as associated with A. J. Ellis in some of his important work on scales) has furnished a valuable short introduction which points out

the relation of the more important specimens to the development of the art. Where the history or authenticity of a certain instrument is of importance the evidence bearing on these points is furnished. No expense has been spared in bringing out the volume, for its preparation is stated to have cost over two thousand dollars.

But unfortunately the work leaves something to be desired. Generally the instruments were placed for photographing in position to show the whole to the best advantage, and especially any ornamental features. This procedure has two disadvantages; the figures being in photographic perspective, they are much distorted and can not be scaled; and while the general appearance of an instrument is well shown, the details that interest the student can rarely be made out. Views taken in different positions diminish somewhat this disadvantage, and the excellent plate XXVIII. of the clavichord action is a notable exception to the general criticism. A useful addition to the descriptions would have been statements of the vibrating lengths of strings, say for all the C's in the principal instruments, and the striking point; also the diameters of the wires where these appear to be the original ones. Almost any details of construction would be welcome, since they are not easily obtained by the student and yet are of great significance in the technical development of the piano. The few cuts of actions are very unsatisfactory; apparently the draftsman was not familiar with mechanism or mechanical drawing, so some of the figures are misleading or unintelligible.

This catalogue, however, in spite of any defects, is a very valuable addition to the small collection of books that illustrate the predecessors of the modern piano, and nothing else can fill its place. CHARLES K. WEAD.

## *SCIENTIFIC JOURNALS AND ARTICLES.*

IN the *Botanical Gazette* for February Mr. Francis Darwin describes a method of studying the movements of stomata, which depends on the fact that when widely open the stomata permit more rapid evaporation than when closed, the leaves becoming correspondingly cooler. The differences of temperature are measured by a Callendar recorder, in which the difference between the temperatures of two fine platinum wires is recorded on the revolving drum. He describes the apparatus and the various tests that were made to discover the errors and limitations of the method.—G. M. Holferty has investigated the development of the archegonium of *Mnium* and reports that a two-celled apical cell is organized by the archegonium initial, that this later gives place to a three-sided one which is truncate, that this terminal cell gives rise to the first cell of the canal row and also contributes to the growth of the neck, that the terminal cell contributes to the growth of the axial row by the addition of cells cut from its truncate face, and that growth in length of the archegonium neck is intercalary as well as apical in both the neck and canal rows. Unusual conditions were found in which the canal series is double for a greater or less distance, in which the venter contains two eggs and two ventral canal cells, in which there was a double venter with two eggs, and one in which a mass of sperm mother cells was developing in the pedicel tissues of the archegonium. Conclusions are drawn that archegonia and antheridia are homologous structures throughout, and that they probably had a common origin from an isogamous gametangium, which in turn was derived from a multilocular sporangium.—Charles E. Lewis, in studies of certain anomalous dicotyledons (*Podophyllum, Jeffersonia* and *Caulophyllum*), finds small embryos surrounded by an abundant endosperm, and a cotyledonar primordium consisting of a broad ridge-like structure opening at one side, the ridge later bifurcating to form the two lobes known as the cotyledons.—F. A. Shriner and E. B. Copeland give definite data in reference to the relation between deforestation and creek flow about Monroe, Wisconsin. —Laetitia M. Snow publishes a preliminary notice of results in the investigation of the effects of external agents on the production of root hairs, showing that there is a relation between the production of root hairs and the elongation of the roots. The same causes which control growth determine the formation

of root hairs.—J. W. T. Duvel records the germination of seeds buried in soil at least three and a half years, the seedlings obtained being 128 in number and representing seven genera and nine species.—Conway MacMillan describes cumaphytism in *Alaria,* showing how strongly the *Alaria*-type of body may become modified by existence in the surf.

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## *SOCIETIES AND ACADEMIES.*

### PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 579th meeting was held January 30, 1904.

Mr. O. H. Tittmann, superintendent of the Coast and Geodetic Survey, gave a brief account of the meeting of the International Geodetic Association during the past summer, at Copenhagen. The most important questions considered during the nine days' meeting were longitude, gravity on land and sea, and variation of latitude.

Mr. L. A. Fischer, of the Bureau of Standards, read a paper on 'The International Bureau of Weights and Measures,' which was established in accordance with an agreement signed by seventeen of the principal nations of the world, including the United States, at Paris, in 1875. A description was given of the laboratory and other buildings, situated on neutral territory in the Park of St. Cloud, at Sèvres, near Paris. An account of the principal work of the bureau was given. This included the comparison of the various national prototypes of the kilogram and meter with one another and with the international kilogram and meter, at present deposited in an underground vault at the International Bureau. The investigation of nickel-steel alloys, the determination of the volume of the kilogram of water, and the establishment of the present standard hydrogen temperature scale were also mentioned. The paper closed with a brief account of the recent comparison of the U. S. Prototype Meter No. 27 with the two standards of the International Bureau. Only preliminary results of this comparison were given, the final results being deferred until further comparisons have been made between No. 27 and the two other copies of the International Meter in possession of the Bureau of Standards.

Mr. James Page, of the Hydrographic Office, then presented the modern view of 'ocean currents.'

Two independent circulations are involved in the movement of the waters of the sea: (1) The vertical, sustained by differences of temperature; (2) the horizontal, having its source in the energy supplied by the wind. The phenomena ordinarily described as ocean currents belong wholly to the latter. These currents have their origin in the impulse given the layer of water immediately at the surface by the wind. This impulse, by virtue of internal friction, is communicated downward, but with extreme slowness; the rate of propagation being expressed by the formula

$$\sqrt{t} = 1736 \cdot x \cdot \frac{v_0}{n}$$

in which $v_0$ is the velocity at the surface, and $t$ the interval (in seconds) required to communicate a velocity $v_0/n$ to a layer at a depth of $x$ meters. Immediately at and near the surface the currents will thus be quite as variable as the winds themselves. The truth of this was shown by a comparison of the observed frequency of winds from the several quadrants with the observed frequency of currents towards the opposite quadrants for various portions of the sea. For the area in the North Atlantic Ocean bounded by the parallels 40°–45° N., and the meridians 30°–35° W. the percentages were as follows:

Winds....N. E. 16, S. E. 20, S. W. 36, N. W. 28.
Currents.. S. W. 20, N. W. 18, N. E. 31, S. E. 31.

At some little distance below the surface these irregularities disappear, in consequence of the sluggishness with which the impulse given by the wind is transmitted downward. Here the changes of the wind, as they occur from day to day, are no longer felt; and the waters probably move in a fixed direction and with a constant velocity, namely, that which the above formula would give them if there prevailed continuously at the surface a wind having the force and direction of the resultant of the actual winds.

At the 580th meeting, held February 13,

Mr. Winston spoke briefly on the plans of a committee of delegates at Paris appointed in the interest of an international auxiliary language intended to serve as a medium of communication especially between scientific men.

Mr. R. A. Harris, of the Coast and Geodetic Survey, in a paper entitled 'On the Feasibility of Measuring Tides and Currents at Sea,' suggested the use of a piano-wire sounding apparatus for such measurements, and ascertained the magnitudes of errors which might be involved when the weight of the wire, impulse of the current and inaccurate estimates of verticality at the surface are involved. The sounding 'lead,' which is not to be recovered in deep water, consists of some weight, a box of stones for example, sufficiently heavy for permitting a suitable tension to be obtained. The measurements of the rise and fall of the tide, as here suggested, necessitate much greater care than do those of the tidal streams and other currents.

Mr. F. J. Bates, of the Bureau of Standards, then spoke on 'The Effect of a Magnetic Field on Plane-polarized Light.' Commencing with Faraday's discovery in 1849, the historical development of the subject was followed and ended with the speaker's work on the rotary dispersion of anomalous dispersing substances. Solutions of fuchsin, cyanin, lackmus and analine-blue were studied with a sensitive-strip spectral polariscope and a magnet which gave 18,000 lines per sq. cm. The differences between 1 cm. cells of solvent and solution were noted. In no instance was it possible to observe an anomaly in the rotation, even though the sensibility of the apparatus was ten times that of preceding investigators. The anomalous effects observed by Schmauss were shown to be due to the effect of the selective absorption of the solutions studied. For a detailed account of the work see Bates, *Wied. Ann.*, No. 13, 1903.

CHARLES K. WEAD,
*Secretary.*

CHEMICAL SOCIETY OF WASHINGTON.

THE 148th regular meeting of the Chemical Society of Washington was held Thursday evening, February 11, in the Assembly Hall of the Cosmos Club. The program for the evening consisted of an address by Professor Wilder D. Bancroft, of Cornell University, upon the subject 'Inorganic Chemistry and the Phase Rule.'

The speaker discussed the subject under the two general heads—the phase rule as an instrument for research and secondly the phase rule as a rational basis for the classification of inorganic chemistry. Under the first of these topics he cited a large number of illustrations of cases to which the phase rule has been successfully applied. Among these was mentioned the work of van't Hoff and his associates upon the Stassfort salt deposits. Also the work which is now being carried on at Cornell University on the bronzes. The application of the phase rule to the separation of mixtures of salts by crystallization was illustrated briefly by referring to the case of a mixture of sodium and potassium chlorides.

A. SEIDELL,
*Secretary.*

THE ELISHA MITCHELL SCIENTIFIC SOCIETY.

THE 152d meeting was held in Person Hall in the Chemical Lecture Room on February 9, at 7:30 P.M. The following papers were given:

DR. W. C. COKER: 'Mendel's Law of Heredity.'

DR. H. V. WILSON: 'Incomplete Division in Vertebrate Animals.'

PROFESSOR COLLIER COBB: 'Composition of Coastal Plain Sands in Relation to Distance from Existing Shore Lines.'

ALVIN S. WHEELER,
*Recording Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

CONVOCATION WEEK.

TO THE EDITOR OF SCIENCE: The first thing to be done in connection with the convocation week meetings of the scientific societies is to secure a more perfect organization. Some man or committee must take up the matter of arranging a complete program so as to avoid the present go-as-you-please condition in which meetings are set at almost any time in the week. This is one of the causes of the

friction and jealousy which detract so much from the pleasure and profit of these annual meetings. One who would like to attend two meetings occurring at the same hour is not in the best humor, and is pretty likely to think that somebody blundered, or that some society is crowding out his society. If I find that A has a meeting set at the same time as B, taking away some members of the latter, I quite naturally blame the A's for doing so, and no doubt the A's blame the B's in return. It may be an almost impossible task to arrange a program so as to avoid such interferences, but without question much can be done to lessen their frequency. I think I know the botanists of the country well enough to be able to say confidently that if a program were made so as to allow time for each association, society and club, we should be a veritable 'happy family.' As it is, there is a remarkably good feeling among American botanists, although some of us think that there is something yet to be desired. It is not enough, in these days of compact organization in all other lines of human effort, that scientific men should be on good terms with one another. They may do their individual pieces of work almost as well, perhaps. But this is not sufficient; scientific men should present a united front; they should be like a well-organized army, and not as isolated guerrillas. We should 'get together' ourselves, into somewhat compact societies or clubs (not too many), and then ask the council or its committee to make such a program as will prevent interference in times of meetings.

The council should be the central organizing body. Its membership should include at least the secretaries of all sections and affiliated societies, in order that the programs of these organizations may be considered in making up the general program. The council should meet for several sessions for general as well as routine business, one day before the public meetings begin. It should have at least one session after the close of the association meetings. Do away with council sessions during the public meetings of the association. Dispense with the formality of referring council action to the general session of the association for ratification.

Now use the evenings for general sessions, in which popular papers and addresses suitable for a general audience are presented. These papers should be short, not exceeding twenty or thirty minutes. Each section might be requested to furnish one such paper or address. Here the lantern might be used to great advantage. By such general sessions the chemists might be able to absorb a little botany, and the botanists a little chemistry, from masters of the subjects. The non-scientific portion of the audience would be benefited and instructed by listening to authoritative and yet non-technical accounts of certain scientific facts and theories.

With the council meetings and the general sessions out of the way the whole of every forenoon could be given to the meetings of the affiliated societies, and the afternoons to the section meetings. Here I should like to suggest that the chairmen of the sections should be elected two or three years before they are to preside, and that the place of meeting should be decided upon as long in advance. We now choose our section secretaries for periods of five years. The earlier election of chairmen would enable the officers to work out better programs.

In the making of section programs the chairman and secretary should *appoint* certain men to prepare papers or addresses. They should *invite* others to do so. This should be done a year or so in advance, in order that time may be given for the work. Then the sectional committee should *select* from the papers or full abstracts, at least two months before the meeting, only as many more papers as may be adequately presented in the allotted time. I like the rule of the London omnibuses which refuse to take more passengers than can be given places better than that which allows an indefinite number to crowd in and fight for even standing room. At St. Louis some of the best botanical papers were crowded out by others which were of little value. I can not refrain from saying again what I have said on more than one occasion before this, that while every man

who has anything to present should have it fully written out, he should not *read* it, but should present a clear, oral summary of it. He should have his matter so well in hand that he can give the audience a good notion of it in from five to ten minutes. Only on rare occasions should any one be allowed to take more than ten minutes, or read details from his paper. In St. Louis I listened to descriptions of details which were useless to present to any audience, since no one could follow them unless he had the object or a drawing of it before him. On the other hand, something should be said as to the duty of listening patiently to what certain men have to say. It is quite childish for men to yawn or even to quit the room because they are 'not interested' in a particular topic. Every man who is given a place on the program is entitled to a respectful hearing.

In regard to the time of meeting, I have first of all one complaint to make in regard to convocation week. When the matter was first talked of I understood that it was to come *after* the Christmas New Year holidays. In many states the state societies have met annually for many years during this week between Christmas and New Year's. It is desirable, if not absolutely necessary, that college and university professors should attend these local meetings. When convocation week was proposed, I supposed it was to *follow* the week already preoccupied by the state societies, but I find that this is not the case, and every winter I must decide whether to run away from the state meetings or to omit the association meetings. Convocation week should come a week later, or the state meetings a week earlier, than now.

As to whether we should meet twice a year or only once, I am inclined to accept Dr. Cattell's suggestion to have a big winter meeting alternating with smaller and less formal summer meetings. This will meet the geographical difficulty by allowing the two meetings to be held in widely separated parts of the country. Thus when the winter meeting is held in Philadelphia the summer meeting preceding or following it might be held in Minneapolis, Colorado Springs, Seattle or San Francisco. And so with a winter meeting in New Orleans, the summer meeting might be held in Portland (Maine or Oregon). I rather like the idea of two meetings because it helps to settle the geographical problems which confront us. The New Englander can scarcely be asked to go to San Francisco, for the distance is too great (although it is no greater than for the Californian to go to Boston). And we can not be expected to hold winter meetings in our far northern cities, nor summer meetings in the south. The two-meeting plan is a good one for this reason.

Lastly, it is evident that this will require a great deal of careful planning, in order that these beneficial results may follow. It will be necessary to fix upon the places of meeting several years in advance, and also to decide upon the general features of the section programs a year or so before the meetings.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

IT has seemed to me that in one respect the American Association for the Advancement of Science is drifting in an unfortunate direction, namely, away from its historic policy of attempting to keep in close touch with the general public and the younger students. A person who has had some scientific training and is interested in the work of the association has usually been admitted to membership if he desired to join. I believe the encouragement to the young student has been invaluable. It has brought young and inexperienced persons into close association with older men who are experienced investigators. The mere association and contact of the inexperienced with the experienced investigator has a great educational value for the former and it serves in addition to stimulate his ambition and to give him an opportunity to put in a word in the discussions or to offer his 'maiden' speech or paper, either one of which gives him better command of his scientific thought and is an encouragement to investigation on his part, with an ambition to offer something more worthy another time. Formerly there was great public interest in the

association and it was more active in interesting the general public. This may be due to one of two causes, or to both: (1) To the change from summer to winter meetings; (2) to the tendency to discontinue the former policy of 'science extension' work, and to the desire to federate the different scientific societies of the country.

With regard to the last question, however much there may be in favor of it, there are, I believe, grave obstacles in the way of securing a satisfactory federation even if it were desirable. There still would remain the definite field of work and the special problems for consideration on the part of specialists and investigators which have led them to organize distinct societies, with membership necessarily determined in some cases on a different basis from that of the American Association. Furthermore, such a federation would not be successful unless it practically included all the prominent scientific societies.

There seems to be a growing feeling on the part of many members that greater emphasis should be laid on the social features of the meeting, *i. e.*, the opportunity for the meeting of friends, for making new ones, and for friendly discussions. This is one of the most wholesome features of the meetings; but large meetings do not encourage this so much as smaller gatherings, for under the present system of making up the programs there are too many papers.

I believe the most successful field for the work of the American Association, since it is a broad and inclusive one, is that of dealing with subjects of more general scientific interest. If the programs of the different sections were confined to subjects of general interest, the papers on the program would be fewer, there would be more time and inclination to discuss them, and the interest would be greater. Printing abstracts in advance, as in the British Association for the Advancement of Science, would increase particularly the opportunity for discussion. More general papers would offer an opportunity for members of different sections to hear something of matters of general interest outside of their own specialty, and would make sectional meetings of greater interest to the general public. The interest of the general public in the work of the association has in the past been one of its aims as shown by the encouragement given to local members by placing them on committees and encouraging them to become temporary members, as well as by the lecture given 'complimentary to the citizens' of the place where the meetings were held.

I believe the American Association might be the means of doing a great work for science in the United States (which the special societies can not do so well) by emphasizing the social features of these gatherings, by emphasizing this feature of science extension in encouraging the interest of its members in the general progress of all departments of science, and by bringing it within the reach of the great mass of secondary school and academy teachers, as well as the educated public who are interested in learning the general results of scientific research. In this way the field for the special societies would be more clearly marked. Many of them would probably be glad to work generally in affiliation with the association, their papers of general interest to be presented before the sections, while each would at other times differentiate into their individual sections for the more technical papers, to which, of course, any member of the association or an outsider would be welcome if he chose to attend.

Then since Science is generally recognized as the official organ of the association its field might be directed more definitely to what might be the field of the association, and cease to publish matter which is not of general scientific interest, or at least cease to publish technical or special notes, which are more appropriately published elsewhere. Science is the medium for the discussion of questions of general scientific interest, for the publication of addresses or papers of general interest presented before the meetings of the association, and for bringing to its patrons weekly summaries of the important and interesting results of scientific research, discovery and travel. This latter feature should be as complete as possible, and Science would form a

weekly hand-book which few of us could afford to be without.

The season of the year when the meetings of the association should be held is, perhaps, one of the most difficult things to decide unless the knot is cut by adopting the suggestion made by Professor E. L. Nichols, that the association is large enough and strong enough to hold both a summer and a winter meeting. Winter meetings could then be held usually in a more southern latitude while summer meetings could be held in the northern states.

Geo. F. Atkinson.

It appears to me that the idea of effecting a union on lines of more or less close affiliation between the various scientific organizations of the country under the leadership of the American Association for the Advancement of Science is in many respects eminently wise and eminently desirable. Large bodies possess more power than small ones. This is the age of consolidation and combinations, and scientific men are not behind the leaders of industrial enterprise in recognizing the fact that 'in union there is strength.' It is to be borne in mind, however, that many of these scientific organizations are composed for the most part of specialists, whose sympathies are only to a very limited extent enlisted on behalf of the broader movement for which the American Association for the Advancement of Science stands. The object which many of the affiliated societies have in view in holding annual meetings is to permit friendly intercourse and the discussion of questions which only indirectly are of interest to the great mass of the membership of the larger organization. In these days of easy communication between all parts of our country the larger organization must hold out to its constituent sections and to its affiliated societies something more than mere sentimental considerations in order to hold these bodies in line with the general movement. Furthermore, the times and seasons adopted for the holding of general meetings must coincide with the convenience of at least a majority of the members of the constituent organizations; otherwise sooner or later these affiliated societies will fall away from the central group.

The idea represented in the movement for a convocation week seems to me theoretically admirable. It, nevertheless, appears to me that the selection of the time for meeting, which has been made, is somewhat unfortunate. There are some things that antedate in their origin, as we all know, the American Association for the Advancement of Science, and among them are the festivals of the Christian year. About Christmas center the joys of the home and of the fireside. In the business world, furthermore, the last days of the old year and the first days of the new year are generally devoted to the settling up of accounts and to the transaction of a vast amount of business, which is more or less engrossing and of genuine importance to men of affairs. People who have families do not care, as a rule, to absent themselves from their homes at the Christmas season. Bidding farewell the day before Christmas to the boys and girls who have returned to the roof-tree from school or college, for the purpose of undertaking a lengthy pilgrimage to a distant city in the interest of scientific discussion, reveals more of the 'martyr-spirit' than is common, except among old bachelors. Most scientific men, so far as my observation teaches me, who have homes of their own, are exemplary husbands and fathers, and while their devotion to science may be keen, they will not feel themselves called upon to neglect what appear to be domestic duties in order to participate in discussions which, it must be said, are often at most of minor and transient importance. I am quite firmly of the opinion that if convocation week is to be generally recognized, and the majority of our societies are to be led enthusiastically to favor gatherings in such a week, the time chosen should fall in the period of mid-summer vacation. The meetings of the American Association for the Advancement of Science and its affiliated societies, held in the summer months, have, as a rule, been eminently successful. The change to the mid-winter holidays seems to me, in common with a multitude of others, who have spoken to me, to be objectionable.

Personally, I desire frankly to say, that, as between staying at home at such a time in the cheerful society of my family and friends, and going to a distant city to endure the doubtful comforts of even the best hotel in the town, for the purpose of discussing the best method of combating the San Jose scale-bug, of collecting dinosaurs, or discovering the fossil fig-leaf aprons of Adam and Eve in the kitchen middens of Kilat-i-ghiljie, I will elect every time the former alternative, and I think I represent the sentiment of a very large number of gentlemen, who are honored by membership in the American Association for the Advancement of Science. We do not yield to any of our brethren in our devotion to science, but at the same time we have not yet come to that point where we are willing to sacrifice our known duty to our wives and children for the somewhat vague benefits of attendance upon meetings where at best we shall not learn much. I am told by one of the officers of the late meeting at St. Louis that very few persons were present at the meeting coming from a distance, except those who stood in some official relationship to the body, and who, therefore, felt compelled to be on hand. Those who were present, besides the official membership of the society, largely represented the local constituency. The reason for this is perfectly plain to my mind in view of what I have already stated. If the American Association insists upon meeting in the last week of the dying year the gatherings are likely to reveal moribundity as the years die in succession.

W. J. Holland.

Carnegie Institute,
Pittsburgh, Pa.,
February 25, 1904.

THE RAPHIDES OF CALCIUM OXALATE.

To the Editor of Science: In your issue of July 24, 1903, I gave a description of a phenomenon observed by Mr. B. J. Howard, of this bureau, showing the collection of the crystals of oxalate of lime in bomb-like cells in certain acrid plants, such as the Indian turnip. I beg to call attention to the fact that Dr. H. A. Weber in the *Journal of the American Chemical Society*, Vol. 13, No. 7, published some interesting data regarding the cause of acridity in certain plants. As the conclusion of his experiments he stated: 'These experiments show conclusively that the acridity of the Indian turnip and calla is due to the raphides of calcium oxalate only.' Dr. Weber's explanation of the destruction of acridity in certain cases where calcium oxalate crystals are found is interesting. He ascribes it to the presence of a thick mucilage, or in cases where starch is present and where boiling destroys the acridity he ascribes this loss of acridity to the production of starch paste. The mucilage and the starch paste serve to restrain the activity of the crystals and prevent them from entering the surface of the tongue and mouth.

Mr. Howard has found that the colocasia leaf, which contains but little starch, retains its acridity when boiled until the acicular crystals are destroyed. The same observation applies to the Indian turnip, which contains a notable percentage of starch. It is probable therefore in all cases that the acridity continues as long as the needle-like crystals are intact. On recrystallization in these cases the lime oxalate assumes the octahedral form and the acridity is not restored. It is only in case the crystals are very fine and sharply pointed that acridity is pronounced. Large and more bluntly pointed crystals produce little or no effect.

Dr. Weber describes also the investigations of Professor W. R. Lazenby on the occurrence of crystals in plants, and states that Professor Lazenby is of the opinion that the acridity of the Indian turnip is due to the presence of the crystals of calcium oxalate. It seems only proper in this connection to call attention to these earlier observations which the experiments described in my letter of the above date fully confirm.

H. W. Wiley.

THE TERM 'BRADFORDIAN.'

To the Editor of Science: On page 24 of the current volume of Science, January 1, 1904, Dr. G. H. Girty is reported as having proposed the term Bradfordian for transition beds between Devonian and Carboniferous. It is not quite clear whether he intends the term

to denote 'a series of rocks' or an 'interval in the time-scale.' In any case, the name Bradfordian is well known to students of European Mesozoic rocks, having been proposed by Desor in 1859, for Upper Bathonian rocks, as exemplified at Bradford-on-Avon in England. Dr. Girty doubtless overlooked this, although he might have found it in Professor Renevier's valuable 'Chronographe géologique' published by the International Congress of Geologists.

It is always a pity when the names of well-known European places are applied by geologists to newly established stratigraphical divisions in other countries. Instances of this, both in the British colonies and in the United States of America, are perplexingly numerous. Even such terms as 'Cussewago' and 'Cuyahoga' are to be preferred.

F. A. B.

## SPECIAL ARTICLES.

### NOTES ON FLUORESCENCE AND PHOSPHORESCENCE.

THE phosphorescent and fluorescent properties of natural minerals have attracted considerable notice and some highly interesting papers have been recently written on the subject, but artificial products of this class do not appear to have claimed much attention.

It is well known that minerals found in one locality may fluoresce brightly under suitable excitation, while other specimens, apparently similar, but taken from another locality, may be unresponsive under a like excitation.

It is also well known that a minute trace of certain substances, when properly incorporated with a large quantity of another substance, will sometimes impart fluorescent and phosphorescent properties to the latter. For example, if a trace of manganese chloride is fused with sodium chloride, the latter will fluoresce red under ultra-violet light, whereas sodium chloride fused by itself will show no color fluorescence. It, therefore, appears altogether probable that the fluorescent properties of some natural minerals is due to the presence of another substance in minute quantity, and in the absence of this constituent an otherwise similar mineral may be non-fluorescent.

The writer having given some study to the artificial production of fluorescent and phosphorescent compounds, is tempted to present a description of a few simple experiments in the hope that their results may prove interesting to other investigators, and thus lead to further developments in this fascinating field of research.

The ultra-violet light used for testing was made by a small high-tension arc produced by a condenser discharge between two iron balls about one half inch in diameter, the air gap being adjustable and the condenser being charged by an alternating current of 60 cycles and 120 volts, stepped up to about 5,000 volts.

*Experiment No. 1.*—Zinc sulphate was dissolved in a small quantity of distilled water holding a trace of manganese sulphate in solution. The mixture was boiled to dryness and then calcined at a full red heat in a porcelain crucible for about thirty minutes. The resulting white powder fluoresced a light pink and phosphoresced an intense red, having the appearance of being *red hot.*

*Experiment No. 2.*—Zinc chloride was dissolved in a small quantity of distilled water holding a trace of manganese sulphate in solution. An equal quantity by measure of soda silicate of a syrupy consistency was then added and the mixture triturated to a thick cream. It was then dried and calcined at a full red heat in a porcelain crucible for about three hours. The resulting white powder showed a light green fluorescence and phosphoresced brightly the same color.

*Experiment No. 3.*—Substituting cadmium chloride for zinc chloride, but otherwise using the same ingredients and treatment as described in the last experiment, the resulting white powder fluoresced a light pink and phosphoresced an orange yellow.

*Experiment No. 4.*—Cadmium sulphate was dissolved in distilled water with a trace of manganese sulphate, evaporated to dryness and calcined at a red heat in a porcelain crucible for fifteen minutes. The resulting powder fluoresced a dull yellow, and phosphoresced a light green. The phosphorescence of

TABULATED RESULTS OF EXPERIMENTS WITH FLUORESCENT AND PHOSPHORESCENT COMPOUNDS.

| Material. | By Natural Light. | By Ultra-violet Light. | | By Roentgen Rays. | |
|---|---|---|---|---|---|
| | | Fluorescence. | Phosphorescence. | Fluorescence | Phosphorescence. |
| Experiment No. 1. | White. | Light pink. | Dark red. | | |
| " " 2. | " | Light green. | Bright green. | Green. | Faint green. |
| " " 3. | " | Light pink. | Orange yellow. | Faint orange. | None. |
| " " 4. | Yellowish. | Brownish-yel. | Light green. | Greenish-yel. | Very faint. |
| Powdered Calcite.* | White. | Bright pink. | Intense red. | Faint red. | Very faint. |
| " Willemite.* | Greenish-white. | Vivid green. | Faint green. | Bright yellowish green. | Very faint green. |

this product was remarkable for its persistency.

The product of experiment number 2 is, in part, a silicate of zinc which somewhat resembles willemite in the color of its fluorescence, but it differs from willemite in being intensely phosphorescent. It is worthy of notice that without the trace of manganese the resulting zinc silicate will show no fluorescence nor phosphorescence, in this respect resembling the non-fluorescent specimens of willemite. An inference may be drawn from this fact as to one of the probable causes of the brilliant green fluorescence of the willemite found in Franklin, N. J.

W. S. Andrews.

Schenectady, N. Y.,
December 29, 1903.

* From Franklin, N. J.

## PALEONTOLOGICAL NOTES.

### PLEUROCŒLUS VERSUS ASTRODON.

In the *Annals of the Carnegie Museum*, Vol. II., p. 12, Mr. Hatcher reaches the conclusion that the dinosaurian genera *Pleurocœlus* and *Astrodon* are identical, and that *Astrodon*, having priority, should stand; furthermore, Mr. Hatcher concludes that *Pleurocœlus* may be the young of some larger species. Both of these conclusions are, it seems to me, open to doubt. The vertebræ and foot bones ascribed to *Pleurocœlus* greatly outnumber all the other vertebrate remains obtained from the vicinity of Muirkirk, Md., the locality where most of the vertebrates of the Potomac formation have been collected. The small, slender, cylindrical, blunt-pointed teeth supposed to be those of *Pleurocœlus* also outnumber all other teeth found in the Potomac formation, so that there is good reason to believe the identification to be correct. The type of *Astrodon* was an imperfect, large tooth, thrice the size of any ascribed to *Pleurocœlus*, and not over four of these teeth have been discovered, while there are none of intermediate size between the two. A section of a tooth of *Pleurocœlus* shows that the enamel is proportionately much thicker than in the tooth of *Astrodon* figured by Leidy, and while this may be partly due to a difference in the planes of the respective sections this evidence is proffered for what it is worth. Finally, it may be said that no large vertebræ or foot bones similar to those of *Pleurocœlus* have as yet come to light, so that for the present it would seem well to accept the validity of this genus.

### THE ARMOR OF ZEUGLODON.

There is such a determined effort nowadays to derive the whales from armored ancestors and to foist a shield and buckler upon *Zeuglodon* that it requires some courage to suggest that at present there is no good *evidence* that either of these theories is correct. If any living cetaceans carry with them traces of armor, it seems strange that no partly armored form has come to light among the abundant cetacean remains found in Miocene deposits. As for *Zeuglodon* (*Basilosaurus*), the only armor that undeniably belongs to this animal consists of a few, somewhat pyriform, slightly keeled ossicles, the largest somewhat greater than a man's fist. There are two of these in the collection of the U. S. National Museum and no other traces of armor have been found, either by Dr. Andrews in Egypt, or by Mr. Schuchert in the southern states. There is no reason to suppose that the irregular fragment in the Koch collection, fig-

ured and described by Dr. Abel, had any connection with the living *Zeuglodon*. The ossicles above referred to are not symmetrical and, therefore, did not lie in the median line, while they are entirely too large to have been attached to the paddles. If a few scattered ossicles on a creature sixty feet long constitute armor, then *Zeuglodon* was a mail-clad animal; otherwise he seems to have been unprotected.

It may not be amiss once more to call attention to the fact that *Zeuglodon* was so highly specialized that it could not have been in the line of descent of modern whales; also that the same strata which contain remains of *Zeuglodon* have yielded half a dozen vertebræ, quite like those of a true whale, and indicating some animal from thirty to forty feet long. When more of this animal comes to light we shall probably have better information on the phylogeny of the cetacea than we have at present.

F. A. L.

### *FOSSIL FISHES IN THE AMERICAN MUSEUM OF NATURAL HISTORY.*

Under an agreement with the trustees of Columbia University the American Museum has recently received on deposit the John Strong Newberry collection of fossil fishes. And this acquisition is noteworthy, in view of the fact that during later years the museum has been securing other important collections of fossil fishes. Among these are the Cope collection, consisting largely of North American forms, from the devonian of Pennsylvania, permian of Texas, carboniferous of Illinois and Ohio, and a very rich series from the Green River shales; the Jay Terrill collection from the devonian of Ohio, a gift of the late Mr. William E. Dodge; and the collection of cretaceous fishes from Mount Lebanon, secured from the American College in Syria by the president of the museum, Mr. Morris K. Jesup. The Newberry collection itself is probably the most important representation of American forms extant; its catalogue includes nearly six thousand numbers, and among these are many of the type specimens described in the 'Monograph on the Paleozoic Fishes of North America' and on the 'North American Triassic Fishes.'

An exhibition of fossil fishes has become, therefore, a need of the museum. And for its installation the director has recently set aside the corner circular room opening out of the reptile gallery. Its arrangement will be in charge of a new curator, Dr. Bashford Dean, a former student of Professor Newberry. The new gallery will include recent forms side by side with their fossil kindred, and will contain special guide cases to illustrate the structure and evolution of the more prominent groups.

### *SCIENTIFIC NOTES AND NEWS.*

Sir John Murray has been awarded the Lütke gold medal of the Russian Geographical Society.

Dr. H. Struve, director of the Observatory at Königsburg has been appointed director of the Observatory at Berlin.

The following fifteen candidates have been selected by the council of the Royal Society to be recommended for election into the society: Dr. Thomas Gregor Brodie, Major Sidney Gerald Burrard, Professor Alfred Cardew Dixon, Professor James Johnstone Dobbie, Mr. Thomas Henry Holland, Professor Charles Jasper Joly, Dr. Hugh Marshall, Mr. Edward Meyrick, Dr. Alexander Muirhead, Dr. George Henry Falkner Nuttall, Mr. Arthur Everett Shipley, Professor Morris William Travers, Mr. Harold Wager, Mr. Gilbert Thomas Walker and Mr. William Whitehead Watts.

Dr. Frederick Peterson has resigned the position of chairman and medical member of the New York State Lunacy Commission.

Dr. L. E. Dickson, assistant professor of mathematics in the University of Chicago, editor of *The American Mathematical Monthly* and associate editor of the *Transactions of the American Mathematical Society*, has been appointed research assistant to the Carnegie Institution. The object of his investigation is the application of group theory to certain problems in geometry and function-theory.

The *N. Y. Evening Post* states that the grant to the Department of Astronomy, of Princeton University, has been increased by

the Carnegie Institution at Washington, on the application of Professor William Maxwell Reed, to $1,200. "This renders possible the use of the telescope on all clear nights in measuring the brightness of certain standard stars." The same newspaper reports that the Carnegie Institution has made a grant of $500 in aid of research work in the Department of Physical Chemistry of the University of Toronto.

S. I. Franz, Ph.D. (Columbia), instructor in physiology in the Dartmouth Medical College, has been appointed physiologist at the McLean Hospital for the Insane, Waverly, Mass.

A dinner in honor of Dr. D. B. St. John Roosa and to celebrate the twenty-first anniversary of post-graduate medical instruction was given in New York on March 2. A cup was presented to Dr. Roosa by Dr. A. H. Smith, and speeches were made by Dr. William Osler, Dr. C. A. Blake, Dr. W. W. Keen and others.

Dr. Simon Schwendener, director of the Botanical Garden of the University of Berlin, celebrated on February 10 his seventy-fifth birthday.

Dr. Edwin Klebs, the eminent pathologist, celebrated his seventieth birthday on February 6.

It is reported that Professor E. von Behring will succeed Professor Robert Koch as head of the Berlin Institute for Infectious Diseases.

Dr. Robert Bell, F.R.S., acting-director of the Geological Survey, Canada, has been appointed a companion of the Imperial Service Order.

Dr. Abbe, professor of physics at Jena, and Dr. Neumann, professor of mathematics at Leipzig, have been appointed members of the Bavarian Maximillian Order for Science.

A gold medal engraved by M. Chaplain has been presented to Professor Bouchard, the eminent French pathologist.

At the annual meeting of the Geological Society of London on February 19, officers were elected as follows: *President,* Mr. John E. Marr; *vice-presidents,* Professor T. G. Bonney, Sir Archibald Geikie, Mr. E. T. Newton and Mr. H. B. Woodward; *secretaries,* Mr. R. S. Herries and Professor W. W. Watts; *foreign secretary,* Sir John Evans; *treasurer,* Mr. W. T. Blanford, C.I.E. Sir Archibald Geikie, vice-president, delivered the anniversary address, which dealt with 'Continental Elevation and Subsidence.' Medals and funds were awarded in the manner already announced.

The Sedgwick prize, for 1903, at Cambridge University, is adjudged to Herbert Henry Thomas, B.A., Sidney Sussex College, for an essay on 'The Petrology of some Groups of British Sedimentary Rocks.'

Professor Charles L. Parsons, New Hampshire College, secretary of Section C of the American Association, who was prevented from attending the St. Louis meeting on account of a severe attack of corneal ulcers, will completely recover his sight. He has been granted three months leave of absence to recuperate in the south.

Professor E. W. MacBride, D.Sc., of McGill University, has been requested to represent the university at the approaching jubilee of the University of Wisconsin.

Rear-Admiral Rixey, surgeon-general of the Navy, and Colonel W. C. Gorgas, U.S.A., are expected to proceed to the Isthmus of Panama to study the sanitary conditions.

The medical journals state that Drs. E. Marchoux and P. L. Simond, of the Paris Pasteur Institute, arrived in Rio Janeiro, February 17, to study yellow fever. A fund has also been raised by the merchants and wharf owners of Hamburg to send Drs. Otto and Neumann of the Institute for Tropical Diseases to South America to study these diseases on the spot.

Mr. James Hornell has been appointed marine biologist to the government of Ceylon with special reference to the pearl beds.

Dr. Hermann Klatsch, professor of anatomy of Heidelberg, has undertaken a scientific expedition to Australia.

Dr. Robert Abbe, of New York City, is to deliver the medical alumni lecture at Yale University, on March 9, on the 'Present Status of Radium as regards its Therapeutic Utility.'

A BRONZE statue of the late Professor Sedgwick, by Mr. Onslow Ford, has been unveiled in the newly erected geological museum of the University of Cambridge.

MR. RUSSELL WHEELER DAVENPORT, a well-known metallurgist, died at Philadelphia, on March 2, at the age of fifty-five years.

THE death is announced of Mr. Henry Michaelson, supervisor of Pike's Peak forestry reserve and a writer on irrigation and forestry matters.

GENERAL CHARLES ALEXANDER McMAHON, F.R.S., died in London, on February 21, at the age of seventy-four years. After performing distinguished military and civil service in India, he took up the study of geology at the age of forty years and studied at the Royal School of Mines under Professors Judd and Huxley when fifty years of age. He subsequently carried on important geological studies of the rocks of the Himlayas and in other directions.

SIR EDWARD SIEVEKING, a well-known physician and author of important works on nervous diseases, died in London on February 24, at the age of eighty-eight years.

DR. V. RODELLA, professor of chemistry at the Technical Institute at Novara, has died as the result of poisoning in the course of chemical experiments.

THE death is also announced of M. Callandreau, member of the Paris Academy of Sciences in the section of astronomy.

THE common council of the city of Detroit has declined Mr. Carnegie's offer of $750,000 for library buildings.

THE Washington *Evening Star* states that congress has appropriated $25,000 for the continuation of Dr. S. P. Langley's experiments on aerial flight.

THE women of the Marine Biological Laboratory at Woods Hole are making an organized effort to raise $5,000 for a dormitory for women students. All those who are interested in this work are earnestly requested to send their subscriptions to the treasurer, Mr. D. Blakely Hoar, 220 Devonshire Street, Boston, Mass.

KING EDWARD has offered one hundred guineas to the proposed London Institute of Medical Sciences.

WE learn from the *Chemical News* that the Chemical, Metallurgical and Mining Society of South Africa has decided to make six awards annually of fifty pounds each, accompanied by a gold medal and diploma, for the following subjects: mining, milling, cyaniding, chemistry (pure and applied), metallurgy (other than milling and cyaniding), and agricultural chemistry. These prizes are open to the members, associates and students of the society. Papers dealing with the South African mining industry are to have precedence in the awards.

THE American Society of Civil Engineers, by a vote of 1,139 to 662, has decided not to become one of the constituent societies in the occupancy and control of the proposed union engineering building, for the erection of which Mr. Andrew Carnegie has promised to give $1,500,000. The civil engineers own a building on West Fifty-seventh Street near Seventh Avenue.

*Nature* states that an astronomical society has been formed at Newcastle-upon-Tyne under the presidency of the Rev. T. E. Espin, who will give the first lecture, at the Literary and Philosophical Society's rooms, on March 11, on 'The Work of an Amateur Observatory.' The honorable secretary of the society is Mr. J. D. Hastings, Warkworth House, Tynemouth.

THE Prussian Government will take over the serum institutions founded in the neighborhood of Marburg by Professor Behring.

REUTER'S Agency is informed that an expedition left England, on February 26, by the steamship *Olenda* for West Africa, under the leadership of Lieutenant Boyd Alexander, who is accompanied by his brother, Lieutenant C. Alexander and Captain G. Gosling. The object of the expedition is to conduct a survey of part of the eastern portions of the Northern Nigerian Protectorate and also to make zoological collections. The expedition will proceed direct up the Niger to Lokoja, whence it will travel along the Benue, afterwards

striking northeast to Lake Chad. The objective of the expedition is Kuka, on the shores of Lake Chad, and it is unlikely that this point will be reached before the end of the year. Lieutenant Alexander's movements after reaching that town are uncertain, as it has not been settled whether the explorers shall seek to penetrate the Great Desert or return *viâ* the German Cameroons. Some specially constructed steel boats for the navigation of the shallow rivers in the Lake Chad region have been made in England. The expedition will probably not return for two years.

*Nature* states that some considerable rearrangements have been made in the museums at the Royal Botanic Gardens, Kew. A new gallery 130 feet long by 16 feet wide at the back of museum No. III. was opened on February 1. To this the entire collection of Gymnosperms (Conifers, Cycads and Gnetaceæ, including Welwitschia) has been transferred. The space in museum No. I. thus set free has been utilized in making a more effective display of its contents, which had become very crowded. The well-lighted wall space in the new gallery has enabled the collection of maps and plans of the establishment at various periods to be brought together. Several of these have been contributed by the late Queen and by His Majesty's Office of Works, and are of considerable historical interest. A set of the fine photographs of Kew in its various aspects which were sent by the government to the Paris Exhibition of 1900 are also shown, as well as an extensive series of photographs of coniferous trees in their native countries.

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## UNIVERSITY AND EDUCATIONAL NEWS.

Harvard University has received a gift of $250,000 from Mr. David Sears, of Boston, a graduate of the class of '47.

Mrs. William E. Dodge has offered the University of Virginia $40,000 for a Young Men's Christian Association building provided other friends of the institution raise an endowment of $20,000.

It is announced that the bequest of James Woolson to Boston University, most of which will not be paid for a long time, will amount to $325,000.

G. H. Myers has given the Forest School of Yale University the library of the late Professor Robert Henry, of Munich, containing about 1,500 books and pamphlets on forestry.

It is announced that Mr. P. N. Russell, who for many years carried on extensive engineering works in Sydney, but has latterly resided in London, has made a further donation of £50,000 for an additional endowment to the School of Engineering at the University of Sydney. Mr. Russell originated this school some seven years since by an endowment of £50,000.

The legislature of the state of Ohio has passed an emergency bill for the temporary relief of the departments of chemistry, pharmacy and metallurgy, the building for which was, as we have already announced, burned to the ground on February 19 at a loss of $125,000.

Denny Hall, a brown stone building belonging to Dickinson College, was destroyed by fire on March 3. The loss is estimated at $60,000, which is said to be covered by insurance.

The University of Toronto has asked the government to provide a new physical laboratory.

King Edward opened the new buildings of the University of Cambridge on March 1. These included a geological museum, a botanical institute, new medical buildings, comprising laboratories and lecture rooms for the departments of medicine, surgery, pharmacology, and pathology and the Humphry museum of anatomy and pathology.

Dr. Alexander Smith, B.Sc. (Edinburgh), who has for some years been associate professor of chemistry in the University of Chicago, has been appointed a professor of chemistry and director of general and physical chemistry in that institution.

Mr. William Harper Davis, fellow in psychology at Columbia University, has been appointed instructor in philosophy in Lehigh University.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES, AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 18, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*
### *SECTION C, CHEMISTRY.*

THE joint meeting of Section C and of the American Chemical Society at St. Louis, December 28 to 31, 1903, was one of the most interesting in the history of the organization. Besides the usual technical papers were those of a physical chemical nature, with several of industrial and commercial value. The general order was varied by one whole session being devoted to a general discussion of valence.

The address of welcome was given by Dr. Frerichs, president of the St. Louis Chemical Society. The response was given by President J. H. Long of the Chemical Society. Dr. Long presided at the Chemical Society sessions and Vice-President Bancroft at the Section C sessions. The address of the retiring vice-president, Dr. Charles Baskerville, was delivered Monday afternoon, subject: 'The Elements: Verified and Unverified.' The address of the retiring president of the Chemical Society, J. H. Long, was delivered Wednesday evening, subject: 'Some Problems in Fermentation.'

The officers for the coming year are:

*Vice-President*—Wilder D. Bancroft, Cornell University.

*Secretary*—R. S. Curtiss, Union College.

*Councilor*—E. H. S. Bailey, University of Kansas.

*Members of the Sectional Committee*—E. C. Franklin, Leland Stanford; M. T. Bogert, Columbia University; L. P. Kinnicutt, Worcester; L. Kahlenberg, University of Wisconsin; G. B. Frankforter, University of Minnesota.

*Member of General Committee*—A. Springer.
*Press Secretary*—G. B. Frankforter.
*Local Press Secretary*—J. H. Knox.

The papers read were as follows:

*The Ternary System, Benzene, Acetic Acid and Water:* A. F. Lincoln, University of Illinois, Urbana, Ill.

It was pointed out by Bancroft about ten years ago that the equilibria between two non-miscible liquids and a consulate liquid follow the mass law, and that there are only two sets of equilibria. The application of the law of mass action to the equilibria of these physical reactions has subsequently been demonstrated to hold very closely in the system, benzene, alcohol and water. Waddell concluded from his experiments that the system benzene, acetic acid and water does not conform to the mass law, and that the equilibria can not be represented by expotential formulas. The work on this system has been repeated by the author, who finds that one of the chief sources of error in a work of this kind is the ascertaining of the point of saturation, that is, of equilibrium. Values are given for temperatures 25° and 35°. The data show that the two equilibria can be represented by two expotential formulas and that, as in the case of chemical reactions, the exponent is not a function of the temperature. The conclusion is that for the system benzene, acetic acid and water, the equilibria do follow the law of mass action.

*Thermometric Analysis of Solid Phases:* Wilder D. Bancroft, Cornell University, Ithaca, N. Y.

When two different solutions of a three-component system belong in the same field and reach the same boundary curve at the same point, the composition of the solid phase in that field can be deduced from the difference in the concentrations of the two solutions. This method has been applied to experiments of Heycock and Neville on gold and cadmium in tin and other solvents, published in 1891. It was shown that the compounds AuCd and $AuCd_3$ are formed. Reversing the process and assuming the existence of AuCd, it is possible to calculate the temperature measurements of Heycock and Neville. This work was done by Mr. E. S. Shepherd and will be published under his name in the February number of the *Journal of Physical Chemistry*.

*A Method of Grading Soaps as to their Detergent Power:* H. W. Hillyer, University of Wisconsin, Madison, Wis.

When a soap solution is caused to make drops beneath the surface of an oil, the number of drops formed by a given volume of the solution increases with the concentration of the solution. The increase in the number of drops with increase in concentration is a measure of the increased power of the solution to emulsify oily matter and consequently to cleanse. Advantage was taken of this connection between the number of drops and cleansing power, to work out a method of determining the cleansing power of commercial soaps. Certain soaps are efficient for use with cold water but not especially good for use with hot water. The reverse is also true. The method grades soaps for these two kinds of use. The cleansing agent is not the alkali of the soap, but the soap in its undecomposed form.

*The Determination of Gliadin in Wheat Flour by Means of the Polariscope:* Harry Snyder, Minnesota Experiment Station, St. Anthony Park, Minn.

The various proteids in wheat flour were briefly discussed and the desirability of a rapid and accurate method for the determination of gliadin noted. Methods based upon the use of the polariscope appeared

to offer a satisfactory way for its determination. The quantity of optically active substances in wheat flour, as sucrose, invert sugar and the non-gliadin proteids soluble in alcohol, was found to be small, and if desired corrections could be made for these substances by precipitating the gliadin and polarizing the filtrate, the gliadin could be determined by difference. It was found that if 15.97 grams of flour were treated with 100 c.c. of 70 per cent. alcohol for 18 hours with occasional agitation, and the filtrate then polarized in a 220 mm. tube, the readings on the sugar scale ranged from —4 to —7 according to the amount of gliadin in the sample. It was also found that the polariscope readings multiplied by .2 gave results corresponding with the per cent. of gliadin nitrogen obtained by the usual process. When the results are substituted in the formula $(a)D = -a/PL$, the value obtained for the specific rotation of gliadin was found to be —90. Kjeldahl and Osborne obtained approximately —92. While only tentative standards could be formulated, on account of lack of sufficient data, it would appear from the results obtained that the polariscope offers a rapid and accurate method for the determination of gliadin in wheat.

*Factors of Availability of Potash and Phosphoric Acid in Soils:* G. S. Fraps.

In the determination of plant food in soils, chemists have usually considered only that part which is soluble in the common solvents. Solubility is not, however, the only factor of fertility in the soil. The rate of decomposition or weathering of the soil is of great importance, as is also the power of the plants to assimilate. Weathering has received little or no attention. It is known to be of great importance with nitrogenous bodies, but in regard to phosphorus and potash no data can be given. Experiments show that there is a slight increase in both phosphoric acid and potash when the soil is kept moist and a great increase in potash when organic matter is present. This accounts for the necessity of vegetable matter in soils. Another factor is the difference in the solvent powers of plants. A soil may contain sufficient food for one plant, but not enough for another.

*Thirty Years' Progress in Water Analysis:* Ellen H. Richards, Massachusetts Institute of Technology, Boston, Mass.

It is hardly possible for the younger chemists to appreciate the benighted conditions in which the early '70's found us. Wanklyn's book, written in 1868, was the first book published on the subject of water analysis alone. Frankland and Armstrong, between 1866 and 1888, made critical examinations of methods, and reached important conclusions as to the meaning of the presence of the various substances in drinking-water.

During this time occurred a bitter controversy over the question whether the whole of the organic carbon and nitrogen or only a certain ratio of the total was important. It must be remembered that at this time chemistry was still young in this country. There were a few laboratories in the better scientific schools and there were a few strong men at work, yet chemistry in general, and water in particular, were far from satisfactory.

My note-book, dated 1872–73, contains, so far as my knowledge goes, the records of the earliest so-called sanitary analyses. About this time the method of reducing to grams was changed to milligrams, and when finally accepted produced astounding results.

The cause of the great discredit to water analysis in the '80's was due to the taking up of the quick and comparatively simple

'albuminoid ammonia' process by inexperienced chemists. Men with little or no training posed and advertised themselves as expert water analysts. What followed can easily be imagined. The public naturally became skeptical, and learned to discredit not only the work of these pseudo-chemists, but also the results of the experts. It was not an uncommon thing, as late as 1895, for samples of water to be sent to four or five different analysts in order to see how widely they differed in their opinions of the same sample. Of course, the fault lay largely with the analysts who assumed that their laboratory tests were all-sufficient.

Great good was accomplished along this line by the Massachusetts Legislature in 1886, resulting in a law entitled 'An Act to Protect the Purity of Inland Waters.' This organization included not only a chemical laboratory, but an engineering, biological and bacteriological staff as well, and the new idea of control of the watersheds and water supplies came to the front in order that selfishness of municipal disposal might be checked out of regard for the general good. This idea has been continued in the various state and municipal laboratories ever since.

At the present time the field of controversy has been somewhat shifted from organic matter to organisms whose pernicious activities are supposed to give rise to the most serious dangers.

*A Study of the Nitrogenous Constituents of Meats:* H. S. Grindley, University of Illinois, Urbana, Ill.

*Object.*—To increase by experimental study the present very limited knowledge of the proteids of flesh, in the condition in which they exist in meat as used for food.

*Method.*—Two samples of lean, raw beef flesh and one sample of cooked beef flesh were extracted successively with the following reagents: Cold water, 10 per cent.; sodium chloride solution, .15 per cent.; hydrochloric acid solution, .15 per cent; potassium hydroxide solution, and lastly hot water. The several forms of proteid and non-proteid nitrogen in each of these extracts were determined.

*Results.*—The detailed results are given in thirteen tables.

*Conclusions.*—1. Cooked meat is much less soluble in the above solvents than raw meat.

2. The acidity of a solution of flesh increases upon the coagulation of its proteids.

3. Cold water extracted 3.06 per cent. nitrogenous matter from raw meats and only .27 per cent. from boiled meat.

4. A 10 per cent. solution of sodium chloride extracted from raw meats 6.10 per cent. of proteid matter and only .5 per cent. from boiled meat.

5. A .15 per cent. solution of hydrochloric acid dissolved from raw meat 2.28 per cent. proteid and from boiled meat 2.30 per cent.

6. A .15 per cent. solution of potassium hydroxide extracted from raw meats 2.88 per cent. and from boiled meat 4.84 per cent. of proteid.

7. Hot water removed from raw meats .49 per cent. and from boiled meats 6.24 per cent. proteid matter.

8. Of the total proteid existing in the original raw meats 95.22 per cent. was dissolved by extracting successively with the above-named reagents, while only 50.59 per cent. of the total proteid of the boiled meat was thus made soluble.

*Some Double Salts of Lead:* John White, Rose Polytechnic, Terre Haute, Ind.

In 1863 the observation was made by Carius (*Liebig's Ann.*, 125, 87) that lead acetate is acted upon by alkyl haloids when heated with them in a sealed tube, using glacial acetic acid as the solvent, and that

a class of compounds is obtained of the general type

$$Pb\begin{cases} x \\ C_2H_3O_2 \end{cases}$$

where $x$ is any halogen. These compounds he designated as the *acetines* of lead.

It is well known that lead sulphate is soluble in alkaline acetates, tartrates, etc., and experiment shows that the halogen salts of lead are also soluble under like conditions. It seems probable that these in passing into solution may form compounds of similar character to those mentioned above.

To test this, experiments were planned, whereby the products of the reaction might be collected and examined. Lead iodide was chosen for the preliminary experiments, because it was found that the products resulting from its solution in acetates and tartrates is white, hence the reaction could be followed by observing the change of color.

The following method of preparation of the salts was adopted: A very concentrated solution of the acetate to be used was first made in alcohol, the strength of which was adjusted for each case, varying from 50 to 95 per cent. To this a few drops of glacial acetic acid were added—otherwise the lead iodide is transformed almost entirely into the basic iodide—and then freshly precipitated lead iodide was brought into the hot solution until it was nearly saturated, the solution filtered and allowed to cool in a vacuum over sulphuric acid.

In each case, upon cooling, well-defined colorless crystals were obtained, which, after draining off and washing with a mixture of strong alcohol and ethyl acetate, were subjected to analysis. In no case, however, was the simple compound

$$Pb\begin{cases} I \\ C_2H_3O_2 \end{cases}$$

corresponding to Carius's salt obtained; instead, the analyses showed that compounds were formed, which may be interpreted as a combination of this with the metallic acetate used. The following salts have so far been isolated and analyzed:

I. $Pb\begin{cases} I \\ C_2H_3O_2 + NaC_2H_3O_2 \cdot \frac{1}{2}C_2H_4O_2, \end{cases}$
melting point (uncorr.) 124–125° C.

II. $Pb\begin{cases} I \\ C_2H_3O_2 + 3NaC_2H_3O_2 \cdot \frac{1}{2}C_2H_4O_2, \end{cases}$
melting point undetermined.

III. $Pb\begin{cases} I \\ C_2H_3O_2 + KC_2H_3O_2, \end{cases}$
melting point 208–208.5° C.

IV. $Pb\begin{cases} I \\ C_2H_3O_2 + NH_4C_2H_3O_2, \end{cases}$
melting point 166–167° C.

V. $Pb\begin{cases} I \\ C_2H_3O_2 + Pb(C_2H_3O_2)_2 \cdot \frac{1}{2}C_2H_4O_2, \end{cases}$
melting point 202–205° C.

They all (with the exception of II.) possess a characteristic crystal form and give fairly sharp melting points. It will be observed that some of them contain acetic acid of crystallization, while others do not, although they were all prepared in a similar manner. When dry they are quite stable, but are decomposed by water or moist air, forming first lead iodide, then the basic iodide. Organic solvents are without action. On account of the insolubility and general inactivity of these substances, it has not yet been possible to determine with positiveness their molecular structure. It is hoped that further investigation may throw additional light upon this point.

*The Theory of Valence:* G. B. FRANKFORTER, University of Minnesota, Minneapolis, Minn.

Valence followed, as a natural consequence, Dalton's atomic theory and the laws of definite and multiple proportion. The first real expression of the present valency theory was made by Frankland, followed by Kolbe and others, who showed

the new idea was in close accord with facts. Notwithstanding the enormous amount of work and speculation of the past fifty years, the idea of valence remains as mysterious as ever. Whether valence represents certain lines of force as a result of some modified application of chemical affinity, or whether it represents certain electrical charges, remains for the future to determine. The electrolytic dissociation theory and the ionization theory would seem to point to the latter as one of the coming theories. Every one must admit that the present valence theory has been of inestimable value in the development of the science, yet none can doubt the fact that the foundation upon which the whole theory rests is by no means a firm one.

*The Theory of Double Salts:* James Locke, Massachusetts Institute of Technology, Boston, Mass.

The present theory of double salts is untenable. In the development of the double-salt theory during the past thirty or forty years, the tendency has been to represent even the most complex of these double compounds as if the valences of the respective elements were absolutely fixed. This condition of affairs has been brought about largely by the organic chemists who have carried the structural arrangement to the extreme, and many compounds are represented by definite fixed formulas without the slightest shade of reason. The salts of hydroferro and hydroferricyanic acids serve as excellent illustrations. The double salts of platinum, as represented by Remsen in his theoretical chemistry, also show the absurdity of the present theory. In fact, the present double-salt conception is without foundation and must sooner or later fall. The Werner theory comes nearer to a logical representation of the double salts than any theory which has yet been proposed.

*Werner's Theory of Valence and the Constitution of Compounds:* J. E. Teeple, Cornell University, Ithaca, N. Y.

The most common objection to Werner's theory is that it discards the present theory of valence, although Werner himself believes that it is only a logical outgrowth of the valence theory. The development of the present theory since the time of Frankland and Kekule may be summed up as follows: (1) A rise in the valence assigned to each element; (2) the increasing use of compact concentric formulas; (3) the common acceptance of the idea of varying valence; (4) the introduction of space relations in formulas, and (5) the growth of the idea of partial or residual valence. The results of the development along these five lines have been remarkable, notwithstanding the fact that no satisfactory explanations are offered for any of the complex compounds and especially the double salts. In fact, Werner's theory is the first to give a satisfactory explanation of the structural formulas as $CoCl_2 \cdot 6H_2O$, $CoCl_3 \cdot 3NH_3$, $CoCl_3 \cdot 4(NH_3)$, $Fe(CN)_6K_3$ and $Fe(CN)_6K_4$.

To understand Werner's theory three concepts are necessary: (1) Primary valence, (2) secondary valence and (3) coordinate number. By primary valence is understood the idea of valence in the ordinary sense as the power of holding together ions or radicals which usually unite with ions. Secondary valence, on the other hand, only combines substances which can not act as ions and are not equivalent to them. The coordinate number of an atom represents the maximum number of groups or atoms with which it may come into direct contact. This number is definite and unvarying for each element: four for carbon, six for cobalt and most of the metals. The number can easily be determined by its ammonia compounds or similar derivatives.

Following out these three concepts, we are able, for the first time, to express such compounds as $CoCl_3(NH_3)_6$ satisfactorily. Thus, around a central cobalt atom are arranged the six ammonia groups attached to the cobalt atom by secondary valences. They are in the first sphere of influence, and hence the whole complex $Co(NH_3)_6$ acts as a single ion. These six groups are probably regularly distributed around cobalt as the central atom and may, therefore, be represented by an octahedron with an ammonia group joined to each of the six vertices. In the second sphere, and not directly connected with the cobalt atom, lie the chlorine atoms. Being necessarily farther removed from the cobalt atom, we should expect more freedom of action for them than for the ammonia, that is, they would act as ions when the salt is in solution. All this may be briefly represented by the formula $Co(NH_3)_6Cl_3$. It has been experimentally proved that such complex ions as $Co(NH_3)_6$ do actually exist in solution and that, in this particular salt, all three chlorine atoms do act as ions.

Werner's theory also explains many hitherto inexplicable phenomena of the simpler compounds. Why does ammonium chloride, $NH_4Cl$, dissociate while the corresponding compound methyl chloride, $CH_3Cl$, its left-hand neighbor in the periodic system, does not? According to the idea given above, the hydrogen in the ammonium chloride would be in the first sphere of the nitrogen, the group $NH_4$ acting as an ion, while the chlorine would act in the second sphere. The compound should dissociate. It does. In the case of the methyl chloride, there is no dissociation because both the hydrogen and the chlorine are in the first sphere of influence and joined directly to the carbon atom. This same explanation also applies to the oxonium, sulphonium, phosphonium, iodonium and diazonium salts.

It is impossible to explain these molecular compounds by the old theory. The very term 'molecular compound' is proof that the old valence is insufficient.

Various attempts have been made to disprove Werner's theory, but in most cases experiments have proved rather than disproved the theory. This is especially true with regard to coordinate number, which gives to each element a fixed number and secondary valence which has a definite limit. It is not understood that this theory was designed to replace the old valence theory in cases of simpler compounds like sodium chloride or in any case where the present theory is satisfactory. It was only intended as an extension of the present theory.

*Solubility of Gold in Certain Oxidizing Agents:* VICTOR LENHER, University of Wisconsin, Madison, Wis.

Metallic gold is soluble in such inert acids as sulphuric and phosphoric when heated in the presence of such oxidizing agents as selenic, telluric, nitric and chromic acids, red lead, lead dioxide, nickelic oxide, manganese dioxide and the higher oxides of manganese. Anode oxygen will also readily cause solution of a gold electrode with electrolytes of either acids or alkali, most of the metal subsequently depositing on the cathode. In case of such salts as sodium sulphate or sodium nitrate, very little of the gold passes through or enters the electrolyte, and the gold anode is completely transformed into gold oxide.

*On a Method for Preparing Salts with a Definite Number of Molecules of Water of Crystallization:* LAUNCELOT W. ANDREWS, University of Iowa, Iowa City, Iowa.

Salts containing a maximum amount of water of crystallization when enclosed in a

tight vessel with a large amount of the same salt in a more or less completely dehydrated condition are, when a condition of equilibrium is attained, converted with precision into a phase containing a definite amount of water greater by one step than that present in the salt used as desiccant. The employment of the method for the removal of mechanically adherent water from highly efflorescent salts, and for the preparation of compounds containing alcohol, benzene or acetic acid of crystallization was also referred to.

*An Interesting Deposit from City Water Pipes:* E. H. S. Bailey, University of Kansas, Lawrence, Kan.

The soft brown deposit, resembling peat, contained the following percentages: Silica, 13.20; water, 27.62; manganese oxide, $Mn_3O_4$, 34.07; ferric oxide, 8.04; alumina, 3.29, and therefore, resembles woad. The water itself only contained a minute trace of manganese.

*A Method of Determining the Total Carbon of Coal, Soil, Etc.:* S. W. Parr, University of Illinois, Urbana, Ill.

The substance is mixed with an excess of sodium peroxide and burnt in the well-known Parr calorimeter. The residue is then mixed with an excess of dilute sulphuric acid and the evolved carbon dioxide measured in a gas burette, the amount of carbon being calculated from the volume of the gas. The amount of carbon in the peroxide used is determined in a special blank experiment. The method gave good results for total carbon in iron, organic compounds, etc.

*The Application of Physical Chemistry to the Study of Uric Acid in Urine:* F. H. McCruden, Boston, Mass.

The greater solubility of uric acid in urine as compared with pure water is shown to be due to the establishment of an equilibrium between the uric acid and the acid phosphates. Hence the addition of even considerable amounts of alkalies, as compared with the uric acid, does not appreciably influence the solubility of the latter. The interesting details of this paper do not lend themselves to discussion in an abstract.

*Investigation of the Bodies called Fiber and Carbohydrates in Feeding Stuffs, with a Tentative Determination of the Components of Each:* P. Schweitzer.

The author presented in tabular form the results obtained by approximate methods of determination of 'pure fiber,' fibro-pentosan, pectose, pecto-pentosan, pentosan, sugar, starch and 'indefinite carbohydrates' in a large number of feeding stuffs.

The following papers were also read:

Herman Schlundt: 'The Dielectric Constants of some Inorganic Solvents.'

Hamilton P. Cady: 'Concentration Cells in Liquid Ammonia.'

James Locke: 'The Action of Ammonia upon Solutions of Copper Sulphate.'

Charles Baskerville: 'Phosphorescent Thorium Oxide.'

Charles Baskerville and George F. Kunz: 'On the Action of Radium Compounds on Rare Earth Oxides and the Preparation of Permanently Luminiferous Preparations by the Mixing of the Former with Powdered Substances.' By title.

Charles Baskerville: 'Action of Ultra-Violet Light on Rare Earth Oxides.'

W. D. Bigelow, H. C. Gore and B. J. Howard: 'The Ripening of Apples.'

John Uric Nef: 'Dissociation Phenomena of the Alkyle Haloids and of the Monatomic Alcohols.' Published in *Liebig's Annalen*, Vol. 318, p. 137.

Edward Bartow: 'Synthesis of the Quinoline Series.'

Arvid Nilson: 'The Life of a Barley Corn.'

G. B. Frankforter,
*Secretary.*

*SECTION H—ANTHROPOLOGY.*

Section H of the American Association for the Advancement of Science held its regular sessions at the fifty-third meeting, which was in progress in St. Louis, Mo., during convocation week. The American Anthropological Association affiliated with Section H. Owing to a meeting of the anthropologists in New York City during the latter part of October, few of the working members were present.

The organization of Section H took place on Monday morning, December 28, immediately after the adjournment of the general session. This session, as well as all the subsequent ones, was held in room 218 of the Central High School. Owing to the absence of the vice-president, Marshall H. Saville, the council granted permission to appoint a vice-president *pro tempore*. Dr. Anita Newcomb McGee was elected to this office. The officers for the meeting were as follows:

*Vice-President*—Dr. Anita Newcomb McGee (in the absence of M. H. Saville).

*Secretary*—George H. Pepper.

*Member of Council*—W J McGee.

*Sectional Committee*—George A. Dorsey, vice-president Section H, 1903; Roland B. Dixon, secretary Section H, 1903; M. H. Saville, vice-president Section H, 1904; George H. Pepper, secretary Section H, 1904–08; William H. Holmes, F. W. Hodge, W J McGee, Miss Alice C. Fletcher and George Grant MacCurdy.

*Member of General Committee*—Amos W. Butler.

Officers of the American Anthropological Association:

*President*—W J McGee.

*Secretary*—George A. Dorsey.

During the meeting the following members of Section H were elected fellows: Frederick W. Hodge and David I. Bushnell, Jr.

Frank Russell, Ph.D., instructor in anthropology in the Peabody Museum, Cambridge, Mass., died in November, 1903, at the age of thirty-five. He became a member of Section H of the American Association for the Advancement of Science in 1896, was made a fellow at the forty-sixth meeting and was elected secretary of Section H for the forty-ninth meeting, which was held in 1900.

Report of the committee on the death of Dr. Frank Russell:

Whereas, The death of Dr. Frank Russell has removed from our ranks one whose career, though brief, was full of achievement and promise; in order to express our appreciation of what he was and what he accomplished, as well as our personal sense of loss through the untimely termination of his labors, we recommend the following resolutions:

*Resolved*, That in the death of Dr. Russell the association has lost one of its most efficient and faithful workers in the field of anthropology, and one whose industry and patience, through years of physical suffering, will remain a noble example to his co-workers and all who knew him.

*Resolved*, That copies of these resolutions be sent to his widow and family, and that a copy be placed among the records of the section.

George A. Dorsey,
George Grant MacCurdy,
George H. Pepper.

The address of the retiring vice-president, Dr. George A. Dorsey, 'The Future of the Indian,' was delivered Wednesday morning in Room 218 of the Central High School.

Owing to the small attendance and in view of the fact that all the members of the American Anthropological Association present were members of Section H, there was no formal meeting of the affiliating association, the vice-president of Section H occupying the chair throughout the meeting.

The following is a list of papers presented, with discussions, and abstracts:

TUESDAY, DECEMBER 29.

*Presentation of Eoliths from England and Belgium:* George Grant MacCurdy.

Paleoliths from the Quaternary deposits of Europe had a long hard struggle for

recognition, which was freely granted only after Sir Joseph Prestwich's visit to Abbeville in 1859. The eoliths are passing through a similar struggle with increasingly brighter prospects of success. It was also Prestwich who came to their rescue at a critical time. Rutot, of Brussels, is their most powerful living exponent. Mr. MacCurdy made important collections last summer both in Belgium and in southern England. The eoliths found in Belgium came from a series of the oldest Quaternary deposits. The specimens found in patches of old southern drift which cap the highest levels of the Kentish Chalk Plateau are still older. If the chipping on them is artificial, it was done by Tertiary man.

This paper was discussed by W J McGee, who said that much of the material from the region under consideration was of such a character that in many cases it was hard to determine whether the chipping was really the work of man or of natural agencies.

*Danish Museum of Archeology:* George Grant MacCurdy.

The present system of museums of northern archeology has been in force since 1880. The center of the system is the unrivaled collection of Danish antiquities in the National Museum at Copenhagen, that alone has enough material from which to write a fairly complete account of northern archeology. Its branches are the ten provincial museums. Seven of these are in Jutland —the largest being at Aarhus—and one each in Fünen, Laaland and Bornholm. Each provincial museum receives annually 1,000 kroner ($280) from the state. In return for this subsidy the museums may be called upon at any time to relinquish important specimens that are wanted for the national collection at Copenhagen, and the director of the national collection is *ex officio* advisory director of all the provincial museums. The latter are not allowed to excavate without a permit from the National Museum authorities, and are, of course, reimbursed for such specimens as are given over to the Copenhagen Museum. At the time of Mr. MacCurdy's visit to Denmark, Dr. Sophus Müller, the director of the National Museum, was making his annual tour of the provincial museums.

While the system is, on the whole, satisfactory, it is defective in so far as it tends to discourage competition. There is no incentive to local pride, hence the provincial treasuries are seldom augmented by gifts from private citizens.

*The Cahokia and Surrounding Mound Groups:* David I. Bushnell, Jr.

Below the mouth of the Missouri, for a distance of some sixty or seventy miles, the Mississippi is bordered on the east by the rich alluvial plain to which the name American bottom is generally applied. Near the center of this area is the largest earthwork in the United States, the Cahokia Mound, which has four terraces and rises to a height of 100 feet above the original surface. Its greatest dimension is from north to south, 1,080 feet; its width from east to west is 710 feet; area at base about fourteen acres. Cahokia is surrounded by a group of more than seventy lesser mounds. The mounds of this group are of two classes, conical and truncated rectangular pyramidal. One and six tenths miles west of Cahokia is a group of five mounds. Extending in a southwesterly direction is a chain of mounds terminating in a group. Twenty-six mounds formerly existed at a place on the bluff opposite these mounds. They were destroyed some years ago and are now covered by houses which form a part of St. Louis. The slope of the bluff eastward from the Cahokia group appears to have been one extensive burial ground.

The name Cahokia applied to the mound group perpetuates the name of an Illinois tribe. There were formerly two groups of small mounds near the center of the western half of Forest Park in St. Louis, the area now known as the world's fair site. These were explored. The average dimensions of the mounds of the smaller group were, diameter 48 feet, elevation 3 feet. Chert, potsherds and charcoal were found on the original surface. They may have been the remains of earth-covered lodges.

George A. Dorsey, in discussing this paper, said that the abandoned villages of the Mandans, Pawnees and other plains tribes had been noted by him, and that the ruins of the fallen earth lodges did not leave a mound, but rather a depression with an enclosing rim.

*The Mounds of the American Bottom of Illinois: Report on a Group Heretofore not mentioned and a New Light thrown upon Their Former Use:* Dr. H. Kinner.

The great group of mounds of the American bottom were described, and their position shown by means of maps. Special attention was given to the Fish Lake group.

The speaker endeavored to show that the earthworks were not of a ceremonial nature, but were built for and used as places of refuge during the time of floods.

Paper discussed by H. M. Whelpley.

*The African Pygmies:* S. P. Verner.

At the request of Mr. Verner, W J McGee presented this paper. He stated that Mr. Verner had spent considerable time among the pygmy tribes of Africa and, at the present time, was on his way to that country to obtain a group of these interesting people for the anthropological exhibit of the Louisiana Purchase Exposition. These savages have rarely been taken from their native wilds and the ones to be brought to America will be the first that have ever visited this country.

Instead of having the regular afternoon session in the room of the Central High School, the section voted to accept an invitation of Professor W J McGee to visit the fair grounds and there listen to his paper on 'The Department of Anthropology at the World's Fair.'

Professor McGee's paper was presented in his office in the Washington University building, and was illustrated with maps and later by means of an inspection of the grounds and buildings that are to be devoted to anthropology.

WEDNESDAY, DECEMBER 30.

*The Future of the Indian:* George A. Dorsey.

This interesting address was discussed by W J McGee, H. M. Whelpley, H. Kinner, A. B. Reagan, Dr. Anita McGee, R. H. Harper and C. E. Slocum.

*The Knife in Human Development:* W J McGee.

The history of the knife was carried back to the time when a water-worn boulder was used instead of a stone with cutting edge. This primitive custom may still be seen among the Seri Indians of Tiburon Island in the Gulf of California and of the mainland. The speaker cited an instance in which a Seri woman was pounding the flesh from the leg of a horse. The implement with which she worked was a rounded stone. In pounding with this hammer it was broken in two, thereby presenting cutting edges that might have been used to advantage. Instead of utilizing this superior form of tool she threw the pieces away and sought another stone with a rounded surface. When the edged tool was first used the natural fractures were no doubt utilized for a long period. Then came artificial chipping with a slow development toward the higher types of cutting implements.

*The Torture Incident of the Cheyenne Sun-Dance of 1903:* George A. Dorsey.

This paper was in the form of a concise account of the dance, the torture which caused the trouble and the charges made by the agents.

John H. Seager and Mr. White sent individual reports to the Commissioner of Indian Affairs in Washington. They charged that Dorsey and Mooney had paid fifteen dollars to an Indian to undergo torture. Seager had previously charged his superior officer with having revived the sun-dance and that it cost six beeves to renew it. This charge was made before the Mohonk conference. It was never investigated. Dorsey demanded that the Indian Department investigate the charges on both sides. He stated that no money was paid for the dance that he saw, and that practically no torture was undergone.

No session was held in the afternoon. The section was invited by the local committee to visit the Cahokia Mound and the surrounding mound groups, and a number of the members took advantage of the opportunity to visit this wonderful earthwork.

THURSDAY, DECEMBER 31.

*The History of an Arickaree War Shield:* George A. Dorsey.

The history of this particular shield was traced from the time that the owner died. The shield was stolen by a member of the tribe. It had been willed to the favorite son of the deceased. The son went to his father's grave and saw a vision. In it a bear appeared, and there were various other phenomena such as the presence of lightning. He found the man who had stolen the shield and regained the inner part of the frame. The cover had been thrown away. He painted the shield, using as decorations the symbols seen while watching his father's grave. Thus he obtained good medicine.

*Presentation of Ceremonial Flint, and Facts Relative to its Discovery:* H. M. Whelpley.

Discussion by George Grant MacCurdy and R. H. Harper.

*Archeology of the Afton Sulphur Springs, Indian Territory:* R. H. Harper.

In this contribution the preliminary work in the Sulphur Springs was described, leading up to the final cleaning out of this interesting ceremonial spring which contained the deposit of stone implements. He mentioned the fact that the oldest Indians of the region were interviewed and all seemed to agree that it was a place of sacrifice. The absence of arrow points within a radius of several miles would tend to show that hunting was not allowed near the spring. Outside of this area a great many stone implements are found.

*The Efficiency of Bone and Antler Arrow Points as shown by Fractured Human Bones from Staten Island, New York:* George H. Pepper.

The Indians of Staten Island were of Algonkin stock and members of the Mohegan tribe. Their village sites and implements have always been in evidence, but no burial places of importance were noted until 1858.

The first exploration work was carried on by Mr. Pepper in 1894, followed by explorations for the American Museum of Natural History of New York City the following year, the latter work being under the direction of Professor Marshall H. Saville. The scene of these operations was a sandy bluff overlooking Raritan Bay in the village of Tottenville.

Many human skeletons were found, the most interesting being three adults, among

the bones of which were twenty-five arrow points. Twelve of these were made of deer antler and four of bone. Many of the bones of the skeletons were shattered and pierced; one rib in particular presents a cleanly cut hole which was made by a long tapering antler point.

At the time of this discovery only one antler arrow point had been recorded from this portion of New York state.

*Certain Rare West Coast Baskets:* H. NEWELL WARDLE.

This paper was read by title.

*Stone Graves and Cremation Cists in the Vicinity of St. Louis:* H. KINNER.

A résumé of explorations in the mounds and bottom lands in the vicinity of St. Louis with an endeavor to determine periods by the manner of inhumation.

*Some Drawings from the Estufa of Jemez, New Mexico:* A. B. REAGAN.

The drawings shown were made by the speaker during a two years' stay with this Pueblo tribe. The paintings from which the drawings were made were cosmic signs which may be noted in many of the estufas in the southwestern pueblos. The element of white contact was shown in the faces depicting the sun and moon.

This paper was discussed by George A. Dorsey, who dwelt upon the fact that it was no easy matter to persuade the conservative Indians of the Rio Grande region to divulge the meaning of their sacred symbols.

*A Glossary of the Mohegan-Pequot Language:* J. D. PRINCE and FRANK G. SPECK.

Read by title. Will be published in the *American Anthropologist*.

The newly elected officers for the Washington meeting are:

*Vice-President*—Walter Hough, U. S. National Museum, Washington, D. C.

*Secretary*—George H. Pepper, American Museum of Natural History, New York City.

GEORGE H. PEPPER,
*Secretary.*

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### CHARLES EMERSON BEECHER.

DR. CHARLES EMERSON BEECHER, professor of paleontology and curator of the geological collections in the Peabody Museum of Yale University, died very suddenly at his home in New Haven on the fourteenth of February, of an affection of the heart. Up to within an hour of his demise he had appeared in his usual health.

Dr. Beecher was the son of Moses and Emily (Emerson) Beecher, born at Dunkirk, New York, October 9, 1856. He was prepared for college at the high school of Warren, Pa., took the scientific course at the University of Michigan and was graduated as B.S. in 1878. His tastes had led him to a study of the native invertebrates, living and fossil, and after graduation he became an assistant to Professor James Hall, State Geologist of New York, and incidentally an expert collector and skilled preparator of fossils, in which the State Museum is so rich. Here he remained ten years, during which he perfected himself in the science of invertebrate paleontology, and then through the influence of Professor Marsh was placed in charge of the collection of invertebrate paleontology at Yale. Here he pursued his studies for the doctorate of philosophy, which he received from the university in 1889, his thesis being a memoir on a group of Silurian sponges. At the instance of Professor Marsh he spent the summer of that year collecting fossils in Wyoming. Subsequently he accompanied Dr. G. Baur on a visit to various European museums. He had had the advantage of a course in geology under Dana, and in 1891–2, during the illness of that veteran teacher, he conducted

the classes in geology. In 1892 he was made the assistant professor of historical geology in the Sheffield Scientific School, and in 1897 full professor and a member of the governing board. March 10, 1902, his title was changed to that of university professor of paleontology. In 1899 he succeeded the late Professor Marsh as curator of the geological collections and became a member of the board of trustees of the Peabody Museum. At the time of his death he was secretary to the board and a member of the executive committee. In 1899 he was elected a member of the National Academy of Sciences, a correspondent of the Geological Society of London and a fellow of the Geological Society of America. In 1900 he became president of the Connecticut Academy of Arts and Sciences and held this office until 1902.

Professor Beecher married, September 12, 1894, Miss Mary S. Galligan, who with two young daughters survives him. The interment was in Grove Street Cemetery, New Haven.

Like most successful students of organic life, Beecher was a born naturalist. As a boy he collected the shells of the region about Warren, Pa., where his home was situated, and his first scientific paper, published in conjunction with Mr. Walker, was a list of the land and fresh-water shells found about Ann Arbor, Michigan, the seat of the state university. The abundance of Devonian fossils about his home at Warren doubtless contributed to his early interest in them. In 1884 he published his first paleontological paper, an essay on the rare Paleozoic crustaceans known as phyllocarida, a subject to which he returned eighteen years later in a memoir which will be classical. Always a field naturalist, after his connection with the Sheffield Scientific School began his opportunities for work in the west became more frequent and fruitful. On becoming curator of the geological collections he presented to the university his private collection of fossils, the result of many years of accumulation and of great scientific value.

Beecher was one of those students who derived from the teachings of Hyatt and Cope those guiding principles in research which have proved so fruitful for American science. By the application of these principles, together with a thorough and minute knowledge of details, he produced those memoirs on the Trilobites, the Brachiopoda and the origin and significance of spines, upon which (with much other worthy work) his reputation in days to come will chiefly rest. Space fails for an analysis of these contributions, which are universally known among professional experts.

Beecher had the artist's gift and his papers were largely illustrated by himself, many of his drawings being of a high order of merit. He had the sense of order and proportion so necessary for a museum expert. He was quiet, cautious, without ostentation, efficient and enthusiastic.

The director of the scientific school has said of him:* "Quiet and unassuming, he never sought adulation, but when there was earnest work to be done, requiring skill, patience and good judgment, he would labor quietly and industriously, bringing to bear upon the problem such a measure of common sense and of thoughtfulness that confidence in and respect for his conclusions were inevitable. * * * No matter how trivial the duty, it was always done at the appointed time and thoroughly done. * * * As a friend he was loyal and trustworthy and his memory will always be cherished by his associates in the Sheffield Scientific School."

One of his pupils has testified to the inspiration given by him to his students, and how his patience, perseverance and inge-

* *Yale Alumni Weekly*, XIII., p. 488, March 2, 1904.

nuity served as an incentive to his associates, who were drawn closely to him by his enthusiasm and entire lack of egotism.

There is no doubt that in the death of Professor Beecher, not only has Yale sustained a serious loss and paleontology a severe blow, but the ranks of those capable of bringing to the study of fossils keen insight and a philosophical spirit of enquiry, guided by principles whose value can hardly be exaggerated, are diminished by one whom science could ill afford to lose, and to whom, humanly speaking, there should have remained many years of industrious and fruitful research. W. H. DALL.

## SCIENTIFIC BOOKS.

### THE MARK ANNIVERSARY VOLUME.*

VOLUMES in celebration of some noteworthy educational event are more common in Europe than with us, and naturally so. The advanced courses of instruction which alone can produce a body of trained disciples have had only about a quarter of a century's existence in America. As time goes on these memorials will doubtless increase in number; at present they can be counted on the fingers of one hand.

Few men have had more influence upon the highest class of zoological work in America than Professor Mark. Leaving his early mathematics and astronomy, he went to Germany, worked there with Leuckart and Haeckel and, on his return, at once entered the teaching force at Harvard. What he has accomplished during these years can only be realized by reading the list of the one hundred and forty former students who sign the appreciative dedication of this volume, and by examining the long list of papers turned out from the laboratory under his charge.

* 'Mark Anniversary Volume To Edward Laurens Mark, Hersey Professor of Anatomy and Director of the Zoological Laboratories at Harvard University, in celebration of twenty-five years of successful work for the advancement of zoology, from his former students, 1877–1902.' New York, Henry Holt and Company. 1903. Pp. xiv + 513; 36 plates.

It is impossible for one man to write a critical review of the twenty-five papers which are contained in this splendid quarto volume. Even a bare summary of the articles will take more space than this journal can spare. All that can be done is to enumerate the papers, with such hints of their contents as will convey some idea of their scope. A fine photogravure of Professor Mark forms the frontispiece; then follows the dedication, to which allusion has been made, and next the papers which make up the volume. These have a wide range of subjects, but one thing which is striking is the small number of strictly embryological articles such as formed the bulk of the work from his laboratory during the first half of his labors at Harvard.

Two of the papers deal with habits. H. R. Linville deals with a couple of tube-building annelids, describing among other things the manner in which they build their tubes; while Jacob Reighard gives a long, detailed and interesting account of the habits of *Amia,* especially during the breeding season and the care of the young.

Four of the papers describe new species. C. A. Kofoid describes a new protozoan, *Protophrya ovicola* allied to *Opalina,* found in the food sac of *Littorina rudis.* S. Goto gives an account of two new medusæ, *Olindoides formosa* and *Gonionema depressum,* from Japan, pointing out that these genera with *Olindias, Halicalyx* and *Gonionemoides* form a natural family Olindidæ, and that the problematical fresh-water genera *Limnocodium* and *Limnocnida* belong near them. Four new species of trematodes, three of them from the air passages of snakes and one from the frog, form the subject of the paper by H. S. Pratt, while H. P. Johnson describes three species of polychæte annelids from the fresh waters of the world, enumerating in his article twenty-four species of the group known to occur in fresh water.

The morphological articles are more numerous. J. H. Gerould discusses the development of *Sipunculus* and *Phascalosoma* from the beginning of gastrulation to the escape of the larva, pointing out that the 'serosa' of *Sipunculus* is a modification of the prototroch

of *Phascalosoma.* Ida Hyde has examined the eyes of *Pecten* with the aid of modern neurological methods, and concludes that our previous interpretation of the function of some parts must be erroneous. H. B. Ward gives a detailed account of several larvæ of the bot fly, *Dermatobia hominis,* which occur as parasites in man and other warm-blooded animals in the tropics.

Two papers deal with the Tunicata. William E. Ritter has a new tunicate, *Herdmannia claviformis,* from California, the anatomy of which is detailed and some facts concerning its development are given. It apparently belongs near *Amaroucium,* but must form a new family. F. W. Bancroft found a colony of *Botryllus* at Naples which partly died down and then exhibited rejuvenescence. The physiology and the structural changes involved are described, the author concluding that deficient nutrition was the cause of the phenomena observed.

H. V. Neal and W. A. Locy both deal with the nerves of sharks. Neal describes the method of the formation of the ventral roots of the spinal nerves, analyzing the fates of various cellular elements which have been described in the cord, and concluding that all the neuraxones are formed from medullary cells and that the cells of the ventral nerves are concerned alone in the formation of the neurilemma and possibly some of the connective tissue. Locy returns to his 'new nerve,' which parallels more or less closely the olfactory nerve. He has now found it in nineteen genera of elasmobranchs, but finds no traces of it in the teleosts and amphibians which he has studied. P. C. Sargent takes for his contribution an account of that peculiar structure, the torus longitudinalis of the teleost brain, which he shows is nervous in character and serves as a center for the receipt of those impulses from the optic nerves which call for quick reflexes. C. H. Eigenmann has been fortunate enough to obtain eggs of the blind fish, and he has given here an account of the development and degeneration of the eye.

R. M. Strong shows that the metallic colors of the feathers on the neck of the domestic pigeon can not be explained as produced by diffraction spectra or by refraction prisms, but that they must arise as thin plate interference colors produced between the contained spherical pigment granules and the outer transparent layer of the feathers.

Thomas G. Lee presents a paper on the fixation of the ovum in the striped gopher, *Spermophilus tridecemlineatus,* the first of a series on the development of this form. The details are not readily presented in abstract, but it is shown that this form differs from all other mammals in the temporary fixation mass.

The only paleontological paper is by C. R. Eastman upon the peculiar selachian fossils, *Edestus* and its allies, which are known chiefly by a peculiar series of structures, often interpreted as spines, but now shown to be a coiled series of symphysial teeth, the structures reaching their extreme in *Helecoprion.*

The subject of variation is treated in two papers by Dr. and Mrs. C. B. Davenport. Dr. Davenport compares the variability of the scallops from Florida and from southern California, showing that the latter are much more variable and correlating this with the more varied environment and the greater geological changes on the Pacific coast. Mrs. Davenport has studied the number of stripes in the sea anemone, *Sagartia leucolena,* and concludes that their number is in part due to longitudinal fission. She also confirms the observations of Torrey and Parker which show that the monoglyphic conditions so frequently found in normally diglyphic hexactinians are to be explained by the same type of asexual reproduction.

The two physiological papers, by G. H. Parker on the phototropism of *Vanessa antiopa* and by R. M. Yerkes on the reactions of *Daphnia* to light and heat, hardly admit of summary. Parker shows that *Vanessa* creeps and flies towards the light, but comes to rest with its head away from strong light. When the eyes are blackened all phototropism ceases. It is not affected so much by strength of light as by the size of the light area, and its retreat at night is largely dependent upon temperature changes. In *Daphnia,* according to Yerkes, phototropism occurs with light of all

intensities and heat seems to have no effect, except in the absence of light, when they migrate to the colder area. Experiments also show that heat does not act in the same way as light upon the organism.

H. S. Jennings points out that in infusoria and in certain rotifers, besides the radial and bilateral types there is a third type, the spiral or at least one-sided, asymmetrical type of structure with a definite relation to the method of movement and life. In the rotifers this asymmetry affects the internal organs as well as the external features which cause the spiral swimming.

The only cytological paper is by R. Floyd, who describes the nerve cells of the cockroach under various kinds of preservation. He concludes that all nervous studies must be controlled by study of the living tissue. The thoracic ganglion cells have no evident cell walls. The cytoreticulum is studied, but no classification of the cells found was possible.

Last to be mentioned is the paper by W. E. Castle and G. M. Allen on the heredity of albinism and Mendel's law. They have experimented with mice, guinea-pigs and rabbits, and find that complete albinism is always recessive. A suggestion is made to account for the phenomena of mosaics, and it is pointed out that cross-breeding frequently brings out latent characters and that this probably affords the explanation of many cases of reversion.

In closing this synopsis of the volume the reviewer may be allowed to praise the mechanical execution of the work. The plates—produced by lithography, heliotype and other photo processes—*illustrate* the papers. The proof-reading has been done in a careful manner, and probably the work owes not a little of its many excellencies to its editor, Dr. G. H. Parker.

J. S. KINGSLEY.

## SCIENTIFIC JOURNALS AND ARTICLES.

*The Bulletin of the American Mathematical Society* for February contains the following papers: Report of the Tenth Annual Meeting of the American Mathematical Society, by F. N. Cole; Report of the Cassel meeting of the Deutsche Mathematiker-Vereinigung, by R. E. Wilson; 'On a Test for Non-uniform Convergence,' by W. H. Young; 'On the Condition that a Point Transformation of the Plane be a Projective Transformation,' by Elijah Swift; 'Note on Cauchy's Integral,' by O. D. Kellogg; Review of Bauer's Algebra, by L. E. Dickson; Shorter Notices of Wölffing's Mathematischer Bücherschatz, Bucherer's Vektor-Analysis, and Ferraris's Grundlagen der Elektrotechnik; Notes; New Publications.

The March number of the *Bulletin* contains: Report of the December Meeting of the San Francisco Section, by G. A. Miller; Report of the Fifty-third Annual Meeting of the American Association for the Advancement of Science, by L. G. Weld; 'On a Gap in the Ordinary Presentation of Weierstrass's Theory of Functions,' by W. F. Osgood; 'On the Theorem of Analysis Situs Relating to the Division of the Plane or of Space by a Closed Curve or Surface,' by L. D. Ames; Review of Hadamard's Propagation des Ondes, by E. B. Wilson; Review of Burkhardt's Theory of Functions, by L. E. Dickson; Notes; New Publications.

## SOCIETIES AND ACADEMIES.

### THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 355th meeting was held on February 9. A letter from Miss Fletcher was read in which she stated that, owing to sickness, she would not be able to deliver the presidential address. A letter from Dr. Daniel Folkmar describing the anthropological work he is carrying on in the Philippines was read by the secretary.

Dr. Ales Hrdlicka exhibited cremated human bones from the Choptank River, Md., collected by Dr. Elmer Reynolds, and stated that they are interesting as the first evidence of cremation in the eastern United States except in Florida. Dr. Reynolds, who was present, described the conditions under which the remains were found.

The first paper of the evening, by Mr. W. E. Safford, discussed the question, 'Were the Aborigines of Guam Ignorant of the Use of Fire?' Mr. Safford showed in the clearest manner the origin of the myth that the Chamorros of Guam were fireless at the dis-

covery of the island, finally running it back to the story of a sailor who had accompanied Magellan. At present the inhabitants of Guam make fire by the plow and saw methods, the latter introduced from the Philippines.

The title of Professor L. F. Ward's paper was 'Monogenism or Polygenism.' Professor Ward added much from the biological side that is new and germane to the topic of man's descent, which long agitated anthropologists until the weight of opinion fell to the balance of monogenism. There is no such thing in nature as a first pair; nature is a becoming; there is no abrupt beginning; monogenism, therefore, is the theory that the human races have all descended by various lines from a common ancestry. Biologists are practically at one as to the descent of all living creatures from one primary source. Polygenism is regarded by them as impossible either for the human race or for animals or plants.

The difficulty is to make this clear to non-biologists, and Professor Ward began by explaining that function is simple, while structure is immensely varied. Functions are the ends to which structures are the means.

For example, there is only one kind of life, and only one kind of mind or reason. There are comparatively few vital functions and the same function may be performed by entirely different structures. This is illustrated by what are called analogies in biology. Flight, for example, is a function, but the wings of insects, birds and bats are all different structures. While functions are always the same, there is complete fortuity in structures, and the same structure would never be independently developed twice. Man is a bundle of structures, and the chances are infinity to one that another being could have independently arisen exactly like him. Following out this idea, Professor Ward said that the inhabitants of Mars, should there be such, could not be like any of our types of animals. Fertility *inter se,* which obtains in all the human races, was also urged as an argument against the possibility of polygenism, and as showing that the lines of descent of the human races are very short.

One of the most important corollaries from the monophyletic origin of man is that all races are of the same age; *i. e.,* all are equally old. There are no 'primitive' races. Man is characterized only by degrees of culture and advancement, but all have taken the same time to reach the point of development in which they are now found.

The paper was discussed by Dr. O. F. Cook, who objected to the use of both monogenism and polygenism and suggested eurygenism as denoting the tendency of all life to ramify.

The 356th meeting was held February 23. The report of the committee on the preservation of American antiquities was heard and the bill which they have prepared read to the society. The matter was referred to the next meeting for discussion.

Dr. Ales Hrdlicka exhibited and described a true fossil human skeleton from the western coast of Florida. Very few such remains have been found in which the organic matter of the bones has been replaced by mineral. The specimens shown are in the National Museum, one of them a skull converted into limonite, the other a fragmentary skeleton, mineralized in somewhat different manner. The former was described by Professor Leidy in 1879. The bones have been analyzed and are found to contain only eight tenths per cent. of organic matter, but the physical characteristics of the skeleton are Indian-like, and do not point to any great antiquity.

Dr. I. M. Casanowicz read a paper entitled, 'Sacrifice as a Means of Atonement and Communion with the Deity.' The origin of sacrifice was assumed to be a homage actuated by fear and the offerings were naturally of food, and the act was a providing for the wants of the god. In ancient belief the spirits of the gods gathered like flies around the sacrifice. It came to be thought that the gods smelt the sweet savor of the sacrifice and that men depended on the gifts of the gods, and conversely the gods depended on the offerings of men. Later the dependence of the gods on men was eliminated and we have sacrifices of another kind, as the human sacrifice, which may emanate from the belief that the value of the gift is proportioned to the privation of the

giver, and the sacrifice of the first born arises and the self-infliction of pain.

The blood relationships between men and gods arising from the organization of men in kindreds with heads, representatives of gods, was discussed by Dr. Casanowicz and interesting examples of the beliefs and rites given.

Dr. B. Rosalie Slaughter, who has recently returned from the east, gave an illustrated paper, entitled, 'A Journey in Korea and North China.' Attractive views were shown of the scenery, villages, architecture and people, with comments on them that showed the thorough acquaintance of Dr. Slaughter with the subject. At the close of the paper the society passed a vote of thanks to Dr. Slaughter for her interesting address.

Walter Hough,
*General Secretary.*

## THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

The fifth regular meeting of the Society for Experimental Biology and Medicine was held on the evening of February 17, in the rooms of the department of pathology of the Cornell University Medical College. Dr. S. J. Meltzer presided. *Members present:* Adler, Calkins, Crampton, Dunham, Ewing, Gies, Jackson, Levene, Lusk, Meltzer, Murlin, Norris, Richards, Wadsworth, Wallace, Wilson, Woodworth, Yatsu. Abstracts* of the reports of original researches follow:

*The Nature and Basis of Sexual Selection in Moths:* H. E. Crampton.

The object of the investigation described was to obtain a quantitative expression for the strength of the mating instinct in certain species of large saturnid moths (*Philosamia cynthia* and *Samia cecropia*), and to determine the correlation between the mating instinct and structural characters. The results of earlier statistical studies upon the pupæ of these species were reviewed, dealing with the nature and basis of the process of natural selection during the period before emergence and at emergence. It was shown that:

1. Those pupæ which die after pupation and prior to metamorphosis are structurally different from and more variable than those individuals which successfully survive the pupal period.

2. Those pupæ which become perfect moths are likewise different from those which can not emerge as perfect moths.

3. The basis for selective elimination is to be sought in correlation between the various structures.

The mating period follows immediately after metamorphosis, when certain individuals with weak mating instinct fail to take part in the production of the next generation, and are thus 'sexually eliminated.' In order to determine the points mentioned above, pupæ of the two species named were isolated as the time for metamorphosis approached, and upon emergence were given one opportunity to mate. It was, therefore, possible to compare the pupæ of the two classes of mating and non-mating individuals. The results, briefly stated, are:

1. That even slightly imperfect moths possess very little mating instinct, or in other words, that with the structural conditions associated with an imperfect power of emergence is correlated a low grade of mating ability.

2. That the mating individuals of the perfect class differ structurally to a certain extent from the non-mating ones, but they are very much less variable than the latter class.

The importance of these results from the standpoint of inheritance and evolution is sufficiently clear to render extended discussion unnecessary.

*Observations on a Serous Fluid of Unusually High Molecular Concentration:* E. K. Dunham.

The fluid was removed from the pleural cavity of a man suffering from lobar pneumonia. The patient was a scene-shifter in a theater and had suffered considerable pain in the chest for four months before his admission to the hospital. His occupation required severe labor for brief periods, during

* The authors of the reports have furnished the abstracts. The secretary has made only a few abbreviations and minor alterations in them.

which he became much heated, with intervals of leisure and exposure to cold drafts of air. The immediate reasons for his admission were a chill and inability to continue work. There was nothing unusual in the clinical course of the pneumonia or peculiar in his treatment. A few days after he entered the hospital 400 c.c. of a clear serous fluid was aspirated from the affected side of the chest and was examined on the same day, with the following results:

Distinctly alkaline, specific gravity, 1021; depression of freezing point, 1.383° C. (mean of three examinations with different portions of the fluid, 1.395, 1.385 and 1.370° C. respectively); electrical conductivity, 0.009119; chlorine calculated as NaCl, 0.58 per cent.; total nitrogen, 0.84 per cent.; nitrogen from washed tannic acid precipitate expressed in percentage of the fluid, 0.83 per cent.; proteid ($N \times 6.25$), 5.21 per cent. of the fluid; traces of reducing substance (sugar?) after removing proteids with ferric acetate; traces of nitrogen liberated by hypobromite of soda; no extractives of appreciable amount upon shaking with ether, acetic ether, or chloroform.

The matter of chief interest in the results was the considerable depression of the freezing point—0.81° C. greater than that by the blood, which was found to be 0.57° C. This 0.81° C. represents nearly 0.438 gram-molecule in solution in excess of the molecular concentration of the blood, and appears to be a clear indication that osmotic interchanges between this fluid and the blood did not freely take place, possibly because of a thick layer of fibrin upon the pleural surfaces. Such a deposit would not, however, explain the high molecular concentration of the fluid. It appears most probable that this was produced subsequent to the formation of the fluid, by cleavages in the larger molecules originally present in solution or by the solution of substances not at first dissolved. These substances could not be dissociable, because the electrical conductivity was rather lower than is usual in such fluids. If the substances causing the high molecular concentration were organic compounds they were not extractives soluble in ether, acetic ether or chloroform.

On the assumption that cleavage products of proteid substances, precipitable with tannic acid, might be present and cause the unusual depression of the freezing point, the following experiments were made: Sterile horse serum, which had not been subjected to heat, was divided into portions. Of these some were kept for controls and others were inoculated with pure cultures of *Staphylococcus pyogenes aureus*, or Fraenkel's pneumococcus. Freezing-point determinations were made on certain of these portions and the rest were sealed up in pipettes holding 100 c.c. each. These were incubated at 37° C. for a week, when freezing-point determinations were made on one of the controls and one of the tubes inoculated with each of the bacteria mentioned. Cultures at this time showed the presence of great numbers of the species used, with no admixture of other species. The remaining tubes were left in the incubator for several months, when cultures proved to be sterile. The results of physico-chemical examination of these sera are tabulated below:

HORSE SERUM A.

*Sterile Controls.*

| | | |
|---|---|---|
| 1903 | °C. | |
| May 19— | $\Delta = 0.580$; | $K = 0.009394$ |
| May 26— | $\Delta = 0.580$; | $K = 0.009491$ |
| 1904 | | |
| Jan. 16— | $\Delta = 0.590$; | $K = 0.009684$ |

*Inoculated with Staphylococcus.*

| | | |
|---|---|---|
| 1903 | °C. | |
| May 19— | $\Delta = 0.585$; | $K = 0.009370$ |
| May 26— | $\Delta = 0.585$; | $K = 0.009674$ |
| 1904 | | |
| Jan. 16— | $\Delta = 0.640$; | $K = 0.010128$ |

HORSE SERUM B.

*Sterile Controls.*

| | | |
|---|---|---|
| 1903 | °C. | |
| May 21— | $\Delta = 0.560$; | $K = 0.009516$ |
| May 28— | $\Delta = 0.560$; | $K = 0.009516$ |
| 1904 | | |
| Jan. 15— | $\Delta = 0.600$; | $K = 0.009897$ |

*Inoculated with Staphylococcus.*

| | | |
|---|---|---|
| 1903 | °C. | |
| May 28— | $\Delta = 0.580$ | |
| 1904 | | |
| Jan. 15— | $\Delta = 0.640$; | $K = 0.010372$ |

These data show but slight changes in the molecular concentration of the sera, and such changes as have occurred occasion an increase in the electrical conductivity as well as in the depression of the freezing-point, showing that dissociable bodies have been produced. The experiments, therefore, fail to explain the high molecular concentration of the serous fluid from the chest; but it is possible that further experimentation in this direction will be more successful.

*An Experimental Study of the Eosinophile Cells during Infection with an Animal Parasite—Trichina spiralis:* Eugene L. Opie. (Presented by James Ewing.)

The administration of *Trichina spiralis* to the guinea-pig causes an increase of the eosinophile leucocytes in the blood, comparable to that which accompanies human infection. There is no constant alteration of the number of these cells until the end of the second week after infection, when their relative and absolute number rapidly increases and reaches a maximum at the end of the third week. At this time embryonic trichinæ are in process of transmission from the intestinal mucosa by way of the lymphatic vessels and the blood through the lungs to the vascular system.

Eosinophile cells accumulate in the mesenteric lymph glands and in the lungs, and form foci which resemble small abscesses in which polynuclear leucocytes are replaced by eosinophile cells. These cells are provided with polymorphous nuclei and do not differ from the eosinophile leucocytes of the circulating blood. Accumulation of the eosinophile cells in the mesenteric lymph glands and in the lungs is explained by the transmission of the embryonic parasites through these organs.

Increase of eosinophile cells in the blood and in other organs is accompanied by characteristic changes in the bone marrow. The fat is diminished in amount and cellular elements replace it. Cells with eosinophile granulation are present in immense number and particularly numerous are the eosinophile myelocytes, cells peculiar to the bone marrow. Eosinophile cells undergoing mitotic division are more numerous than usual.

The number of eosinophile leucocytes in the blood always diminishes before death, so that the proportion is usually less than one per cent. Infection with a very large number of trichinæ causes a rapid diminution of the number of eosinophile leucocytes and is quickly fatal. The eosinophile cells of the bone marrow exhibit degenerative changes of which nuclear fragmentation is most characteristic. Similar changes may affect the eosinophile cells of the intestinal mucosa and of the mesenteric lymph glands. Mild infection stimulates the eosinophile cells to multiplication, but severe infection causes their destruction.

*Subcortical Expressive Reflexes and their Spinal Pathways:* R. S. Woodworth.

Dr. Woodworth reported on some experiments done in collaboration with Professor Sherrington in the latter's laboratory. It was shown that in a recently decerebrated cat powerful sensory stimuli evoked reactions such as in a normal animal would be expressive of pain, anger and other similar emotions. Such reactions are, therefore, primarily subcortical reflexes and not dependent on the organ of consciousness. The 'ether cry' also appeared in decerebrate animals. The sensory spinal pathway, by which these signs of pain were aroused, was found by experiments in which partial cross-sections of the cord were made, to run, not in the posterior, but in the lateral columns. The pain pathway from either side of the body runs up both halves of the cord, but more largely up the opposite half.

*An Experimental Study of the Cause of Shock:* W. H. Howell. (Presented by S. J. Meltzer.)

Professor Howell's experiments were made upon dogs anæsthetized with morphia and ether, and brought into a condition of shock by operations of various kinds. Blood-pressure records were obtained in the usual way during the experiment. The following general conclusions were reached:

1. The most important and dangerous feature of severe shock is a long-continued, practically permanent fall in blood pressure to about 20–40 mm. of Hg. This condition is

designated as vascular shock and is due to a long-lasting loss of activity of the vaso-constrictor center.

2. A second important result of shock is a very rapid and feeble heart beat. This condition is designated as cardiac shock; since, although it may result secondarily from the permanent fall in blood pressure, it may also occur quite independently of the vascular shock as a primary result of the operations. Cardiac shock, so far at least as the rate of beat is concerned, is due to a more or less permanent loss of activity of the cardio-inhibitory center.

3. Intravenous infusions of alkaline salt solutions ($NaCl$, 0.6 per cent.—$Na_2CO_3$, 0.5 per cent.) cause a rise of pressure by increasing the force of the heart beat. The effect is more durable than with salt solution alone and may be renewed by repeating the injection.

4. The fundamental cause of vascular and cardiac shock is not exhaustion of the vasomotor and cardio-inhibitory centers from overactivity, but a more or less permanent inhibition of these centers from excessive stimulation of the inhibitory paths.

*New Members.*—Drs. Isaac Levin and J. P. Atkinson were elected to membership.

Officers for the ensuing term were elected as follows:

*President*—S. J. Meltzer.
*Vice-President*—James Ewing.
*Secretary*—William J. Gies.
*Librarian*—Graham Lusk.
*Treasurer*—Gary N. Calkins.

William J. Gies,
*Secretary*.

### THE AMERICAN MATHEMATICAL SOCIETY.

A regular meeting of the American Mathematical Society was held at Columbia University on Saturday, February 27. The American Physical Society met at the same time and place, and an especially interesting feature of the occasion was the presidential address of President A. G. Webster of the Physical Society on 'Some practical aspects of the relations between physics and mathematics,' which was delivered before a joint session of the two societies.

The attendance at the meeting of the Mathematical Society was about forty-five. President Thomas S. Fiske occupied the chair at the regular sessions and at the joint session with the Physical Society. The following new members were elected: Mr. E. P. R. Duval, Harvard University; Professor G. A. Goodenough, University of Illinois; Mr. H. C. Harvey, State Normal School, Kirksville, Mo.; Dr. J. G. Hun, Princeton University; Dr. T. P. Running, University of Michigan. Nine applications for membership in the society were received.

Professor E. H. Moore, who had served as editor-in-chief of the *Transactions* since its inception in 1900, was reelected to the editorial board for a term of three years.

The following papers were presented at this meeting:

William Findlay: 'The Sylow subgroups of the symmetric group.'

L. P. Eisenhart: 'Three particular systems of lines on a surface.'

Joseph Bowden: 'The definition of sine and cosine.'

H. E. Hawkes: 'The quaternion number systems.'

L. E. Dickson: 'On the subgroups of order a power of $p$ in the linear homogeneous and fractional groups in the $GF[p^n]$.'

C. M. Mason: 'On the solutions of $\Delta u + \lambda A(x, y)u = f(x, y)$ which satisfy prescribed boundary conditions.'

F. N. Cole: 'The groups of order $p^3q^\beta$.'

Edward Kasner: 'Galileo and the concept of infinity.'

E. W. Brown: 'On the smaller perturbations of the lunar elements.'

E. B. Van Vleck: 'On the convergence of algebraic continued fractions whose coefficients have a limiting form.'

Henry Taber: 'Hypercomplex number systems.'

Edward Kasner: 'On the geometry of ordinary differential equations.'

Ida M. Schottenfels: 'On a theory of functions related to a hypercomplex number system in two units.'

G. D. Birkhoff: 'A general remainder theorem.'

The members of the two societies lunched together in the interval between the sessions,

and a representative number were present at an informal dinner arranged for the evening.

The next meeting of the Mathematical Society will be held at Columbia University on April 30. The Chicago Section will meet at Northwestern University, Evanston, Ill., on April 2. The San Francisco Section will meet at Stanford University on April 30.

F. N. COLE,
*Secretary.*

## DISCUSSION AND CORRESPONDENCE.

### CONVOCATION WEEK.

THE present multiplicity of scientific societies appears to have its origin in four conditions: (1) in adaptation to the present differentiating or specializing tendency in science; (2) in adaptation to the magnificent distances in this country; (3) in historical peculiarities of origin, notably the former existence of both summer and winter meetings, and (4) in sundry failings of human nature. In so far as this multiplicity is due to the first condition, it is inevitable, if not actually desirable; in so far as it is due to the second, it is necessary; in so far as it is due to the third, it is susceptible to an appeal to reason and public spirit; while as to the fourth, it must be allowed for in any plans for improvement of existing conditions. The other extreme from the present multiplicity, viz., consolidation into a single great many-sectioned society, seems to me, for the above reasons, not only impracticable, but highly undesirable. There is no real analogy between the conditions of scientific progress, which depends much upon individualism and little on organization, and the conditions of a great business where organization is in itself of prime importance; and it is a mistake to suppose that the benefits of consolidation would be as great in the one case as in the other. The real task before us, I believe, is to seek and to achieve that optimum in number and kinds of societies which lies somewhere between the present uneconomical maximum and the unattainable and undesirable minimum of a single society.

Some of the essential conditions of this optimum seem to me these. It must provide for yearly meetings in each of the great natural divisions of the country, the eastern, central, (and ultimately) western and Pacific sections; for, so great are the distances, and so high the cost in money, time and effort required to cover them at the midwinter season, that a far greater aggregate attendance on scientific meetings, with the resultant benefits, will be secured by this system than can possibly be attained by any single meeting, however central. Furthermore, it is a mistake to suppose that the biggest meetings are, other things being equal, necessarily the best; there is much to be said for the greater profit, as well as pleasure, of smaller meetings. While, of course, a single great society could meet in geographical divisions, it is certainly wiser to utilize for this purpose the existent arrangements, namely, local meetings organized under the auspices of the American Society of Naturalists. There are other reasons, also, why a second group of societies in addition to the American Association is desirable: (1) A vigorous but friendly rivalry will be distinctly advantageous, and much preferable to a society monopoly, and (2) since the American Association is unlimited as to qualifications of membership, and must always have and care for a large semi-scientific or popular element in its activity, there is certainly a need for other societies which will be strictly scientific in their membership and able to conduct their affairs upon a purely scientific basis. I think, therefore, it is very desirable that both the American Association and the American Society of Naturalists should exist, the former meeting in different sections of the country in different years, and devoting itself to the more general aspects of the sciences, and the latter forming a center for the meetings of the more technical scientific societies, and holding a meeting each year in each of the great geographical divisions of the country. The relations between the two should be friendly and cooperative, and that division of the American Society within whose territory the American Association happens to meet should always combine with it in joint meetings, the other divisions meeting in their own territory. It might be advantageous at certain intervals, of not less

than five years for all the divisions and societies to hold one meeting in common.

This does not, however, touch one of the most serious phases of the present situation, namely, the existence of many independent societies within the same science, a condition especially pronounced in botany. Not only does this entail a great waste of effort, but it deprives the science of the advantage and prestige of a powerful national body which can speak and act with authority in the interests of the science. At the same time each science is becoming so specialized that it is more agreeable and profitable for those interested in the same phase of it to meet by themselves. It is customary to deprecate this tendency, on the ground that specialists should keep more in touch with other phases of their science as well as with other sciences. But in practise I think this segregation is inevitable, and not undesirable or, at all events, it represents the lesser in a choice of evils. A specialist in one branch of a science can not keep in touch with another branch by suffering through technical papers read on that latter phase; he can accomplish this result much better around the social table in the evenings, and by listening to, or reading, those admirable summaries of progress in other branches which it is becoming more and more the custom to present in vice-presidential addresses, in semi-popular lectures by great specialists, etc. The best solution of this particular problem seems to me to lie in the combination of all the societies devoted to a certain science into a single strong national society, which shall be divided into as many sections as there are special phases, attracting enough men to form working sections, and which shall hold simultaneous meetings in the great geographical centers, along with the other scientific bodies affiliated with the American Society of Naturalists. This can undoubtedly be accomplished without the abandonment of any of the existent societies, through their transformation into the special sections of the national society.

W. F. Ganong.

I beg leave to submit the following plan for increasing the usefulness and influence of the American Association for the Advancement of Science:

*Organization.*—In addition to the present organization, establish a branch in each community where there are a number of members of the association.

*Meetings.*—In addition to the general meeting, have each section meet once a year and each branch once a month, or oftener if it should appear to be profitable.

*Publications.*—Publish Science as at present, and in addition publish all the papers presented at the section meetings and the more important of those presented at the branch meetings (in the *Transactions*); issuing a set of the *Transactions* for each section.

In nearly every community there is a demand for some organization of those interested in science; so we see science clubs in nearly every university. These clubs form social centers for the scientists of the communities, and their meetings offer an opportunity for their members to report on and discuss the work which they are doing. In most cases they would be willing to reorganize as branches of the American Association for the Advancement of Science if given considerable freedom in the character of organization. The parent society could charter a branch on receiving a copy of its constitution, which should make provision for a report of each meeting, being sent to the general secretary. Each will then have the advantage of cooperation while still having freedom of government.

The best time for holding the general meeting, at which the social element should be emphasized, appears to be in the early summer. Each section would hold its meeting in connection with the general meeting as at present; but in addition would hold a meeting during convocation week, the summer meeting being given to the more general papers and excursions, while the more technical papers would be presented at the winter meeting. These winter section meetings need not be held all at the same place, and if desirable any section might hold two simultaneous meetings at different places.

Science is serving a very useful purpose now in publishing the vice-presidential ad-

dresses and the abstracts of all the papers, as well as serving as a clearing house for scientific thought. The objection may be raised that publishing all the papers would make the *Transactions* too expensive. The answer to this is that the present fee should cover the general expenses and Science only, while the *Transactions* should be sold by subscription; each member subscribing for the *Transactions* of those sections in which he may be interested.

This plan would provide more time for the presentation of papers; provide meetings at which matters of somewhat local interest could be discussed; allow the sections a choice as to the place of meeting, and provide a place where all papers could be found instead of having them scattered through many periodicals. The economy of this plan as to both time and money would probably check the formation of new societies and also lead to the abandonment of many now organized; which are ends much to be desired.

Arthur H. Ford.

### OUR FUTURE 'PUBLIC ANALYSTS.'

The era of *scientific* investigation and protection of our food products and standard drugs, in distinction to the medico-political attempts of the past twenty years, is apparently at hand, and, as time will undoubtedly demonstrate, in proper hands. To be sure a certain few boards of health and food commissioners have at various times accomplished much in partial food inspection and one or two, notably the Massachusetts Board of Health, through its efficient secretary, Dr. Abbott, have rigidly inspected both foods and drugs for many years, bringing the universal fifty per cent. adulteration of those foods, etc., that can be adulterated, as shown by investigation statistics in other states, down to about fifteen per cent. and keeping it there. In these few widely separated states the legislatures will no doubt 'let well enough alone,' and, if appreciative at all of what has been accomplished, will increase the appropriation, which in nearly every case is absurdly small at present. In the forty odd states as yet unawakened or only partially awakened to a realization of our national negligence in this great economic question, it is gradually becoming apparent that the state experiment stations are, or soon will be, the logical and most appropriate institutions to entrust the collection, investigation and subsequent defined inspection work to; the 'food commissioner' (if that be what he is called) being merely a prosecuting officer, which in general is the arrangement (and doubtless a satisfactory one) in Connecticut at present.

There are several gradually developing and well-founded reasons why we must begin to consider these well-organized, federal and state supported, scientifically equipped branches (in their chemical work) of the Bureau of Chemistry at Washington in this light. In the first place, there is very little adulteration of food products harmful from a hygienic standpoint. Physicians of course must be able to depend upon the strength of the drugs they prescribe, but otherwise the whole subject is really an economic one, closely related to agriculture, horticulture and animal industry, the three most important lines of experiment station work. Secondly, the Bureau of Chemistry, under Dr. Wiley's direction, already has charge of the examination of imported food products and, as soon as the long-delayed federal food law becomes effective, will have charge of the interstate commerce aspect of the question, thereby greatly assisting the states in their necessary local work. In several states, notably Connecticut, Pennsylvania and Kentucky, the experiment stations already carry on the state investigation and food inspection analysis work. Thirdly, these stations are financially and scientifically able to carry on research work upon the composition, nutritive value, utility, etc., of new or little-understood foods, simultaneously with official inspection work; and finally the chemists of these stations in their official association, commonly spoken of as the A. O. A. C., have recently studied, compiled and published provisional official methods of food analysis (at present, however, better adapted to investigation work rather than to rapid inspection and legal work), and defined the standards that legally pure food products should conform to.

In their annual convention in Washington, in November, a most important place in the program has been given to the whole subject, and soon afterwards many of the stations will undoubtedly establish special laboratories for investigation and possible inspection work, carrying out a suggestion made by the Office of Experiment Stations in Washington, a number of years ago (Bulletin No. 17).

So much for the experiment station and the probable part it will play in the solving of an economic question wherein we are a half century behind European nations. The natural and very important question next arising is relative to our future 'public analysts,' that comparatively large body of specially trained chemists, presumably young, considering the meager salaries usually allowed for routine laboratory work, who will be required in every state, and often at a moment's notice, by the experiment stations and by every state, county or municipal board of health or officer charged with the enforcement of locally protective legislation. These men will not only have to be already familiar with the modern methods of food and drug investigation and rapid legal inspection analysis, especially microscopical methods, which are frequently the only ones showing the nature and approximate proportion of the adulterant as the courts always require; but they will find that, upon the expert witness stand, a quite thorough knowledge of the natural composition, nutritive and economic value, utility, methods of adulteration and character of usual adulterants of foods is indispensable. The first contested prosecution, a grocer, backed by a large manufacturing concern and furnished with the best of legal aid and an experienced chemist looking for flaws and coaching said legal aid, was the experience demonstrating to the writer the above requirements; and one hundred and fifteen other mostly successful and often contested cases since, only serve to emphasize the fact in his mind.

In the British Isles the 'public analysts' constitute the best trained, most progressive and finely organized class of practical chemists to be found, their official association, the Society of Public Analysts, being always consulted by the government on any subject involving analytical chemistry, and their journal, *The Analyst*, being the leading and almost the only publication devoted to analytical chemistry in the English language. These chemists are trained in special schools or special university courses and, after passing an examination, including the whole subject of foods and drugs and their chemical and microscopical examination, are admitted to membership in the Institute of Chemistry and become eligible to appointment by counties or municipalities inspecting or intending to inspect the local food, drug and water supplies. Now let us turn to the status of affairs in our own country. It is said, and it will be generally admitted as true, that if, in the season of legislative activity, a half dozen of the as yet unawakened states were to pass laws protecting and governing the sale of foods and drugs, it would be impossible to find the necessary number of specially trained analysts ready and competent to undertake the work at hand. Of course, plenty of chemists with the ordinary college training in analytical chemistry or some other special training would be found and appointed, but so long a period of confidence acquiring study and practise would be necessary before any prosecutions were advisable, that the temporarily enthused legislature and public would forget about and lose all interest in the work and decide that it had been found to be unnecessary or impolitic—a condition of affairs that the grocery and druggist organizations would not be slow to take advantage of, as has been shown more than once in the not remote past.

Yale University has recently outlined courses in several of the afore-mentioned necessary subjects, and has engaged Winton, state chemist at the Connecticut Experiment Station, to give the necessary instruction in lectures and laboratory work. A few other large universities are planning to, and doubtless will, introduce similar and perhaps more complete courses in the near future. With the exception of Yale and possibly Harvard, however, they will not have the distinct advantage of having the students brought in

direct contact with official work and official chemists. In the forty-eight state colleges or universities, partially supported by the federal government through the land grant and Morrill acts, we have, however, practically the same number of very conveniently situated and well-equipped institutions for training, at least the locally needed, public analysts of the future. That their location is especially fortunate for this purpose is due to the fact that nearly all the experiment stations are located in the same towns and in fact are often really departments of the university or college, with a staff made up principally of members of the college faculty. Some of these public educational system extensions, Cornell University and the University of California, for examples, must of course be considered as better officered and equipped than many of the others, especially those in the far south and southwest.

All, however, if their catalogues and the Office of Experiment Stations statistics are trustworthy, have the facilities (departments, professors and laboratories) wherewith to give instruction in the subject of foods, their composition, nutritive and economic value, methods of adulteration and detection of the same, etc.; and in the senior year or as post-graduate assistants give the students an opportunity to gain an insight into and a little actual experience in food investigation work, and also if possible, in methods of rapid legal inspection work at the local experiment station, or at least from the official chemists of these stations. The preparatory subjects, which we may consider as junior year electives, would include organic chemistry and outlines of organic analytical methods (fat extractions, melting point determinations, etc.), histological botany and microscopy and physiology, especially the subjects of nutrition, digestion and assimilation. In the senior year the really special studies would be undertaken, viz., the study of foods as previously outlined; the natural composition, nutritive and economic value, utility, methods of adulteration, etc., of foods being taught by lectures, while the methods of scientific investigation and rapid legal inspection, especially the use of the microscope and the utilization of histological botany, would be taught simultaneously in the laboratory.

Whether this senior year specialization led to a special degree, or to the ordinary bachelor's degree in science only, is immaterial. One thing is assuredly certain, however, and that is that such a comparatively simple, wholly possible and practicable course of training, especially if supplemented with actual experience in the local experiment station, would supply a national and soon to be a pressing need for competent trained 'public analysts,' similar to those regarded necessary by the smallest and least pretentious English towns and cities. Then, and then only, will our American Society of Public Analysts acquire a membership and influence sufficient to warrant its admittance as a section of the older society in the mother country or, perhaps, what is more patriotic, a similar relationship to the American Chemical Society.

R. O. BROOKS.
STATE LABORATORY OF HYGIENE,
TRENTON, N. J.

### THE MISUSE OF 'FORMATION' BY ECOLOGISTS.

GEOLOGISTS, paleobotanists and a few botanists have several times called attention during the past few years to the persistent misuse by many ecologists of the word 'formation,' when referring to plant societies or associations. Regardless of the sanction of a century or more of usage for 'formation' in the geological sense, they have proceeded within the past dozen years to transplant the word, viâ Germany, into English botanical literature, unmindful of the fact that where employed in the German language it is little or not at all confusing, but when translated into English comes in direct competition with well-established usage in other fields. The usual reply to these protests has been that this employment of 'formation' has the sanction of the earlier writers in this 'newly discovered' field of ecology, and, moreover, is hardly likely to lead to any serious confusion with its use in geology, mineralogy or paleobotany. If those

who hold this view will take the trouble to look in the issue of Science for January 29, page 170, they will find enumerated a list of papers read before Section G (Botany) at the recent American Association meeting, two papers: 'Plant Formations in the Vicinity of Columbia, Mo.,' and 'The Distribution of some Iowa Plants; Formations on which they Occur.' Here, in succeeding papers, the word 'formation' is employed with two distinct meanings. The first paper, we learn from the abstract, deals with the several associations of living plants found in the locality treated of, while the second is 'A brief account of some of the more important plants found growing on the Carboniferous sandstones in eastern Iowa.' Suppose some one had read a paper, as might very appropriately have been done at the same meeting, on the 'Plants of the Potomac Formation of Maryland and Virginia,' would it be a paleobotanical, a geological or an ecological paper?

In this connection I may perhaps be pardoned for calling attention to the title of another ecological paper in the same number of Science (p. 169), viz., 'The Flora of the St. Peter Sandstone in Iowa.' This as it stands is calculated to cause a decided stir in paleobotanical circles when it is remembered that the St. Peter sandstone in Iowa is of Silurian age, and, so far as I know, has not thus far been found plant-bearing! It is only fair to add, however, that the second part of the title ('An Ecological Study') explains its scope, but the fact seems to remain that ecologists, aside from their misuse of terms, do not always sufficiently consider the titles for their papers.

F. H. Knowlton.

Washington, D. C.,
February 3, 1904.

## SPECIAL ARTICLES.

### ON TITLES FOR PAPERS.

One of the indirect advantages of the individual card catalogue will be that of the condensation of titles, since a man who has been often called upon to fill up several lines of a $3 \times 5$ card with the title of a four-page paper will become considerate of others, and reduce the titles of his own future articles to their lowest terms. There is in this regard the greatest disparity of usage among different authors and different schools. Thus in general it may be said that the fashion of long and ponderous titles is a characteristic of the English school, as may be seen by consulting the pages of the *Quarterly Journal* or the *Journal of Anatomy and Physiology*, in the last of which the size of the title is still farther set out by being printed entirely in large capitals. The opposite seems to be the case with Gegenbaur and his followers, as may appear by consulting the *Morphologisches Jahrbuch*, where occasionally, among others of moderate length, an exceptionally terse title meets the eye. An especially good example of this is Maurer's 'Blutgefässe im Epithel,' which another would have expanded into 'Ueber das Vorhandensein von capillaren Blutgefässe im Epithel der Mundschleimhaut bei einigen einheimischen Amphibien.' It is apparent that Gegenbaur himself set the lead in this movement, as may be seen by the titles which he employed, most of them those of masterpieces, 'Die Epiglottis,' 'Zur Morphologie des Nagels,' 'Ueber das Archipterygium,' 'Clavicula und Cleithrum,' etc.

There seem to be two main reasons for employing lengthy titles, first, the desire to show the limitations, the point of view and the treatment of the subject, giving rise to the *explanatory title*, and, secondly, the desire to appear sufficiently modest, to show how keenly one feels the vastness of the subject and how little has really been accomplished; the *modest title*.

A recent example of the first has just appeared in a leading journal, and with its twenty-four words leaves little to the imagination of the reader concerning its scope. This may well have been unavoidable in this case, but for the benefit of cataloguers it might be suggested that in such instances there might be used a title and a subtitle, the former short and for the use of the card index and general bibliographies, the other longer and more explicit, to assist the reviewers and those who have actually taken the work into their hands.

As a timely warning and to show what the outcome of this tendency may become if not

properly checked, I will quote the following, which is a masterpiece of descriptive writing, and leaves little doubt concerning the various standpoints from which the subject has been treated:

SACHS, Phil. Jacob. *Γαμμαρολογία sive gammarorum, vulgo cancrorum consideratio physico-philologico-historico-medico-chymica, in qua præter Gammarorum singularem naturam, indolens et multivarium usum non minus reliquorum crustatorum tractatio ad normam collegii naturæ curiosorum plurimis inventis secretionibus naturæ artisque locupletata.* 8vo, Francofurti et Lipsiæ, 1665.

On this head I may state as a sort of confession, that in an early article of my own I employed a title of eighteen words to designate the same number of pages. There may possibly have been reasons other than the length of the title which denied me the pleasure of seeing this article extensively quoted, but in my own later experience I know that an article of indifferent value may often be saved for a bibliography through the merit of having an easily quotable title.

Modest titles, or those in which the author acknowledges that the final word has not been said upon the subject, usually begin with 'A contribution to the study of,' 'A few points in the anatomy of,' 'Observations upon the structure and development of,' and seem to be especially popular with younger investigators. While composed in the most laudable sipirit, such titles are hardly necessary, since there is little danger of a misunderstanding on the point guarded against by the writer.

There are in all probability other forms of lengthy titles besides those touched upon here, and it is certain that titles may have numerous other defects besides length, but this article is intended as a protest, not a treatise; in short, '*a contribution to the study of the relative length of scientific titles, including an inquiry into the cause and origin of those that may be considered excessive, together with suggestions concerning the remedy for the same.*'

HARRIS HAWTHORNE WILDER.

SMITH COLLEGE,
February 6, 1904.

ELLIPTICAL HUMAN RED CORPUSCLES.

IN this short note the writer desires to place on record a peculiar anomaly in human red blood corpuscles. This interesting variation came to notice in the histological laboratory of the Ohio State University in October, 1902. The class at that time was studying the human corpuscles, and the attention of the laboratory assistant, Mr. Seymour, was attracted by the sketches made by a student who had represented the red corpuscles by elliptical outlines. Examination disclosed the fact that the colored corpuscles in the sample recently drawn by the student from his own finger were elliptical and not circular.

The student was directed to prepare another specimen, using a perfectly clean slide and cover-glass, and he followed directions closely, covering the slide as quickly as possible. The corpuscles were observed to have the same shape as before. Professor Bleile and Dr. Morrey confirmed the observation, and at Professor Bleile's suggestion numerous samples were taken by several people and the specimens invariably showed the same peculiarity. It was deemed advisable to extend the observations over a period of several weeks, subjecting the corpuscles to the action of various reagents, and also making measurements of the size of the cells.

To this end the writer carried the work on during a period of four months, specimens being taken at various intervals. The reactions to such reagents as water, dilute caustic potash, dilute acetic acid, dilute hydrochloric acid, tannic acid, etc., were normal, but in each specimen taken many cells having the abnormal shape were noted. The erythrocytes were distinctly elliptical, slightly biconcave, non-nucleated cells which did not adhere in rouleaux. In many of them the biconcavity was scarcely perceptible. It was estimated that 90 per cent. of the red cells did not have the circular outline of normal corpuscles. It was also shown that these cells were elliptical whether they were subjected to the pressure of a cover-glass or not. This seemed to be the only manner in which they differed morphologically from the normal cells, except in the slight degree of biconcavity. As this dif-

ference proved to be a permanent one, and not a variation caused by accident or error in technique, it was deemed worthy of being placed on record.

A large number of corpuscles were measured, but only the extremes and averages are here presented. They are as follows:

| | |
|---|---|
| Shortest width observed | 3.9 microns. |
| Greatest width observed | 4.8 microns. |
| Shortest length observed | 8.5 microns. |
| Greatest length observed | 10.7 microns. |
| Average length | 10.3 microns. |
| Average width | 4.1 microns. |
| Ratio of width to length | 1:2.5. |
| Average thickness | 2 microns. |

Thus it is seen that the outline was distinctly elliptical, the long diameter being on the average two and a half times the shorter diameter. It is also to be observed that the above figures differ considerably from those of the normal red corpuscles, which vary from 7.2 microns to 7.8 microns. The thickness was practically the same as that of the normal red corpuscles. The number was five millions per cubic millimeter and the quantity of hæmoglobin was up to the standard. The colorless corpuscles presented no peculiarities.

The student in whose blood these corpuscles were found was a healthy mulatto about twenty-two years of age. His brother, who attended the university a few years ago, had normal red blood cells. Other than this no family history is at hand.

Melvin Dresbach.
Ohio State University.

## *NOTES ON ENTOMOLOGY.*

Auguste Barbey, an expert Swiss forester, has published a review of the Scolytidæ of central Europe.* They are treated from a systematic standpoint, but after the description of each species there is usually a considerable amount of biological matter. With each species of great destructive power is given the best means of combating it. A number of the European species also occur in the United States, so that the book will be of great value to all American students of forest insects. The excellent plates illustrate the insects and their work; several of the latter are particularly fine.

*The Münchener Koleopterologische Zeitschrift* is a new entomological journal, devoted to the study of palæarctic beetles. It is issued from Munich, and edited by Drs. Karl and Joseph Daniel. Volume I. (1903) is now complete and contains over 400 pages. A large majority of the articles are systematic, and consist of reviews and revisions of genera and groups, and descriptions of new species and varieties. This volume contains Dr. Ganglbauer's notable classification of the coleoptera. He criticizes the recent classifications of Lameere and Kolbe, and presents a new one, which, in general, is like that of LeConte and Horn (1883). There are seven leading groups of families, but the groups Clavicornia and Serricornia of those authors are arranged under the groups Staphylinoidea and Diversicornia. It would appear, however, even from the names of some of the groups, that a logical classification of the beetles is a thing only to be hoped for.

The British Museum of Natural History has issued an elaborate account of the African tse-tse flies, prepared by Mr. E. E. Austen.* The fact that one species (*G. morsitans*) carries the germs of the Nagana disease lends great interest to the study of these flies. This disease, so fatal to domestic animals, was supposed to be due to a poison injected by the bite of the tse-tse fly. All travelers in those regions have been delayed or disheartened by its ravages in their animals. And Mr. Austen suggests that were it not for the tse-tse fly, the entire history of South Africa would have been different. Although as long ago as 1879 it was suspected that the tse-tse fly was merely the carrier of a blood-parasite, it was not so proved until 1895 by Col. Bruce. This parasite was then described by Plimmer and Bradford as *Trypanosoma brucei*. Mr. Austen devotes many pages to the recital of the ravages of the disease, quoting from many works of travel. Detailed technical descriptions are given of the seven species of the genus, one of

* 'Les Scolytides de l'Europe Centrale,' Geneva, folio, 120 pp., 18 plates (also a German edition).

* 'A Monograph of the Tse-tse Flies (*Glossina*),' with a chapter on the mouthparts, by H. J. Hansen, London, 1903, pp. 319, 9 pls.

which is new. The beautiful plates illustrate the species. Dr. Hansen has described the mouth-parts and compared them to the allied genus, *Stomoxys*, the stable-fly of this country and Europe. A map is given showing the known distribution of *Glossina* in Africa.

It may be added that Lieut. Col. Bruce, who worked out the life history of the trypanosome of Nagana, has lately discovered that another species of tse-tse fly, *G. palpalis*, is the carrier of the trypanosome of sleeping sickness.

Dr. Adolph Lutz has published an account of the life history of an injurious Brazilian *Anopheles*.* This mosquito, which is the carrier of the germ of an intermittent fever, is a small species of *Anopheles*, *A. lutzi* Theobald. In the locality where the sickness occurred there are very few pools of stagnant water. Dr. Lutz, therefore, sought for other breeding places, and found the larva of this species in the cavities of various epiphytic plants of the family Bromeliaceæ. He also found the larva of a *Megarhinus* feeding upon the other culicid larvæ. Two species of *Culex* were also bred from the water in the cavities of these plants. The article shows the difficulty in the tropics of localizing the breeding places of mosquitoes.

Mr. C. T. Brues has added considerably to our limited knowledge of the Stylopidæ.† From Texan species of *Polistes* which he kept in confinement he obtained females and bred males of two new species of *Xenos* (*X. pallidus* and *X. nigrescens*). Upon these, and a large series of *X. pecki* collected in Connecticut by Dr. Wheeler, Mr. Brues has made a study, principally of the early stages of the embryo and the origin of the eggs. He finds no similarity between the Stylopidæ and the Coleoptera, and concludes that the former should form a separate order of insects—the Strepsiptera.

The second volume of Bingham's 'Hymenoptera of British India'* contains the ants and cuckoo (or golden) wasps. There are 398 species of ants described, representing probably one of the largest ant-faunas in the world. There are many notes of a very interesting nature on the habits of some of the ants. Of the cuckoo-wasps (Chrysididæ) 79 species are described. The colored plate shows some of these handsome insects.

Dr. J. Vosseler has given an attractive account of his studies on the Orthoptera of Algeria and Tunis.† The first part contains notes on the physical condition of the country, the rôle of wind in the distribution of the forms, and an annotated catalogue of the species (224 in number). Part second has a chapter on the distribution of these species in the Mediterranean fauna, one on the markings and adaptive appearances in Acridiidæ, notes on the squirting of blood by various species, and on the odor-glands in one genus —*Œdaleus*.

The squirting of blood, or the body-fluid, is considered as a means of defense. In *Eugaster* there is a hole in the legs near the coxa through which the blood is forced; in *Platystolus* there is a slit at the posterior part of the pronotum. Many of the species are confined to desert regions, and of these a number are protectively colored when at rest, yet when flying display the brilliant colors on their hind wings. Some of the species vary considerably, and one colored plate is devoted to the variations in *Eremobia crista* Fabr.

Dr. C. G. Attems has published a synopsis of the geophilid myriapods of the world.‡ It consists of a chapter on the structure of the family, a synopsis to genera and species of the palæarctic forms, a catalogue of the species of other countries, and descriptions of many new species, mostly non-European. Altogether about 290 species are mentioned.

* 'Waldmosquitos und Waldmalaria,' *Centralbl. f. Bakter. Parasitenk. u. Infektionskrankheiten*, Bd. XXXIII., pp. 282–292, 1903, figs.

† 'A Contribution to our knowledge of the Stylopidæ,' *Zool. Jahrb., Abt. f. Anat.*, Vol. XVIII., pp. 241–270, 1903.

* 'The Fauna of British India, including Ceylon and Burma; Hymenoptera,' Vol. II., London, 1903, 506 pp., 1 pl., 161 figs.

† 'Beiträge zur Faunistik und Biologie der Orthopteren Algeriens und Tunesiens,' *Zool. Jahr.*, Abt. f. Syst., Vol. XVI., pp. 338–404, 2 pls.; Vol. XVII., pp. 1–98, 3 pls., 1902.

‡ 'Synopsis der Geophiliden,' *Zool. Jahr.*, Abt. f. Syst., Vol. XVIII., pp. 155–302, 6 pls., 1903.

Dr. J. C. Nielsen has two papers in the same volume of the same periodical. One treats of the development of *Bombylius pumilus,* a fly parasitic in the nest of a bee—*Colletes daviesiana.* He shows that when the *Bombylius* is ready to issue the pupa bores through the earth, and does not follow the channel of the nest. The second article is on the life-history of the longicorn beetle, *Oberea linearis.* The female beetle, after the manner of our Oncideres, cuts off the twig of hazel just beyond where it has deposited an egg. It takes two years for the young to reach maturity.

About two years ago a French woman, Marie Pellechet, offered a prize for a work on the insects injurious to books and their bindings. The committee in charge of the prize awarded it to Constant V. Houlbert, and his essay has been published.* It is the most complete work yet written on the subject. He treats of 60 different species, and gives remedies or means of prevention as far as known. There is a bibliography of 94 numbers, from which the author has drawn for most of his facts. He finds that the worst insect enemies of books are the species of *Anobium* and allied genera, known to the French as 'Vrillettes.' The remedy chiefly advised is fumigation, based on American methods.

NATHAN BANKS.

## THE EIGHTH INTERNATIONAL GEOGRAPHIC CONGRESS, WASHINGTON, 1904.

THE executive committee of the Seventh International Geographic Congress, held in Berlin in 1899, having voted to convoke its next session in Washington, the National Geographic Society, as the organization responsible for the management of the sessions in the United States, will welcome the eighth congress and its friends to the national capital of the United States in September, 1904.

Geographers and promoters of geography throughout the world, especially members of geographic societies and cognate institutions of scientific character, are cordially invited to assemble in Washington, D. C., on September 8, 1904, for the first international meeting of geographers in the western hemisphere.

On the invitation of the National Geographic Society, the following societies join in welcoming the congress and undertake to cooperate toward its success, especially in so far as sessions to be held in their respective cities are concerned:

The American Geographical Society.
The Geographic Society of Baltimore.
The Geographic Society of Chicago.
The Geographical Society of California.
The Mazamas.
The Peary Arctic Club.
The Geographical Society of Philadelphia.
The Appalachian Mountain Club.
The Geographical Society of the Pacific.
The Sierra Club.
The American Alpine Club.
The Harvard Travellers Club.

The congress will convene in Washington on Thursday, September 8, in the new home of the National Geographic Society, and will hold sessions on the ninth and tenth, the latter under the auspices of the Geographic Society of Baltimore. Leaving Washington on the twelfth, the members, associates and guests of the congress will be entertained during that day by the Geographical Society of Philadelphia, and on the thirteenth, fourteenth and fifteenth by the American Geographical Society of New York, where scientific sessions will be held; on the sixteenth they will have the opportunity of visiting Niagara Falls (*en route* westward by special train), and on the seventeenth will be entertained by the Geographic Society of Chicago; and on Monday and Tuesday, September 19 and 20, they will be invited to participate in the International Congress of Arts and Science connected with the World's Fair in St. Louis. Arrangements will be made here for visiting exhibits of geographic interest. In case any considerable number of members and associates so desire, a far-west excursion will be provided from St. Louis to the City of Mexico, thence to Santa Fé, thence to the Grand Canyon of the Colorado, and on to San Francisco and the Golden Gate, where the western geographic societies will extend special hospitality, afterward returning by any preferred route through the Rocky Mountains and the interior plains to the eastern ports.

* 'Les insectes ennemis des livres,' pp. 269 + 38, 3 pls., 59 figs., Paris, 1903.

If the membership and finances warrant, the foreign delegates will be made guests of the congress from Washington to St. Louis, *viâ* Baltimore, Philadelphia, New York, Niagara Falls and Chicago. On the far-west excursion special terms will be secured, reducing the aggregate cost of transportation, with sleeping-car accommodations, and meals, materially below the customary rates. It may be necessary to limit the number of persons on the far-west excursion. It is planned also to secure special rates for transportation of foreign members from one or more European ports to New York, provided requisite information as to the convenience and pleasure of such members be obtained in time. Final information on these points will be given in the preliminary program of June, 1904.

The subjects for treatment and discussion in the congress may be classified as follows:

1. Physical geography, including geomorphology, meteorology, hydrology, etc.
2. Mathematical geography, including geodesy and geophysics.
3. Biogeography, including botany and zoology in their geographic aspects.
4. Anthropogeography, including ethnology.
5. Descriptive geography, including explorations and surveys.
6. Geographic technology, including cartography, bibliography, etc.
7. Commercial and industrial geography.
8. History of geography.
9. Geographic education.

A special opportunity will be afforded for the discussion of methods of surveying and map-making, and for the comparison of these methods as pursued in other countries with the work of the federal and state surveys maintained in this country.

Members of the congress will be entitled to participate in all sessions and excursions, and to attend all social meetings in honor of the congress; they will also (whether in attendance or not) receive the publications of the congress, including the daily program and the final *Compte Rendu*, or volume of proceedings. Membership may be acquired by members of geographic and cognate societies on payment of $5 (25 francs, one pound, or 20 Marks) to the committee of arrangements. Persons not members of such societies may acquire membership by a similar payment and election by the presidency. Ladies and minors accompanying members may be registered as associates on payment of $2.50 (12½ francs 10 shillings, or 10 Marks); they shall enjoy all privileges of members except the rights of voting and of receiving publications.

Geographers and their friends desirous of attending the congress or receiving its publications are requested to signify their intention at the earliest practicable date, in order that subsequent announcements may be sent them without delay and that requisite arrangements for transportation may be effected. On receipt of subscriptions, members and associates' tickets will be mailed to the subscribers. The privileges of the congress, including the excursions and the social gatherings, can be extended only to holders of tickets.

It is earnestly hoped that the congress of 1904 may be an assemblage of geographic and cognate institutions no less than of individual geographers; and to this end a special invitation is extended to such organizations to participate in the congress through delegates on the basis of one for each one hundred members up to a maximum of ten. No charge will be made for the registration of institutions, though the delegates will be expected to subscribe as members; and in order that the list of affiliated institutions (to be issued in a later announcement) may be worthy of full confidence, the committee of arrangements reserves the right to withhold the name of any institution pending action by the presidency. The publications of the congress will be sent free to all institutions registered. It is especially desired that the geographic societies of the western hemisphere may utilize the opportunity afforded by this congress for establishing closer relations with those of the old world, and to facilitate this, Spanish will be recognized as one of the languages of the congress, with French, English, German and Italian, in accordance with previous usage; and communications before the congress may be written in any of these languages.

Institutions not strictly geographic in character, libraries, universities, academies of sci-

ence and scientific societies are especially invited to subscribe as members in order to receive the publications of the congress as issued.

Members and delegates desirous of presenting communications before the congress or wishing to propose subjects for discussion are requested to signify their wishes at the earliest practicable date, in order that the titles or subjects may be incorporated in a preliminary program to be issued in June, 1904. The time required for presenting communications should be stated, otherwise twelve minutes will be allotted. It is anticipated that not more than twenty minutes can be allotted for any communication unless the presidency decide to extend the time by reason of the general interest or importance of the subject. The presidency with the complete organization of the congress will be announced in the preliminary program of June, 1904.

All papers or abstracts designed for presentation before the congress, and all proposals and applications affecting the congress, will be submitted to a program committee, who shall decide whether the same are appropriate for incorporation in the announcements, though the decisions of this committee shall be subject to revision by the presidency after the congress convenes.

Any proposal affecting the organization of the congress or the program for the Washington session must be received in writing not later than May 1, 1904. Communications designed to be printed in connection with the congress must be received not later than June 1, and any abstracts of communications (not exceeding 300 words in length) designed for printing in the general program to be published at the beginning of the congress must be received not later than August 1, 1904. Daily programs will be issued during the sessions.

All correspondence relating to the congress and all remittances should be addressed to the Eighth International Geographic Congress, Hubbard Memorial Hall, Washington, D. C., U. S. A.

*Committee of Arrangements*—W J McGee, National Geographic Society, *chairman;* Henry G. Bryant, Geographical Society of Philadelphia; George B. Shattuck, Geographic Society of Baltimore; A. Lawrence Rotch, Appalachian Mountain Club, Boston; Zonia Baber, Geographic Society of Chicago; George Davidson, Geographical Society of the Pacific, San Francisco; Frederick W. D'Evelyn, Geographical Society of California, San Francisco; John Muir, Sierra Club, San Francisco; Rodney L. Glisan, Mazamas, Portland; Angelo Heilprin, American Alpine Club; Herbert L. Bridgman, Peary Arctic Club; William Morris Davis, Harvard Travellers Club; J. H. McCormick, *secretary.*

*Finance Committee*—John Joy Edson, *chairman,* president Washington Loan and Trust Company; David T. Day, United States Geological Survey; Charles J. Bell president American Security and Trust Company.

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## THE SIXTH INTERNATIONAL CONGRESS OF ZOOLOGY.

The Fifth International Congress of Zoology held at Berlin in 1901, selected Switzerland as the place of meeting for the sixth session, and elected Professor Doctor Th. Studer president.

The congress will meet at Bern from August 14–19, 1904.

The general committee consists of the following gentlemen:

*President*—Dr. Th. Studer, professor at the University of Bern.

*Vice-Presidents*—Dr. E. Beraneck, professor at the Academy of Neuchâtel; Dr. H. Blanc, professor at the University of Lausanne; Dr. V. Fatio, Geneve; Dr. L. Kathariner, professor at the University of Fribourg; Dr. A. Lang, professor at the University and at the Polytecknicum of Zurich; Dr. E. Yung, professor at the University of Geneva; Dr. F. Zschokke, professor at the University of Bâsle.

*General Secretary of the Standing Committee of International Congresses of Zoology*—Dr. R. Blanchard, professor of the Medical Faculty of Paris.

*Secretaries*—Dr. M. Bedot, professor at the University of Geneva; Dr. T. Carl, assistant to the Museum of Natural History of Geneva; Dr. W. Volz, assistant to the Zoological Institute of the University of Bern.

*Treasurers*—Mr. E. Von Büren von Salis, banker, Bern, and Mr. A. Pictet, banker, Geneva.

*Committee on Scientific Works*—Besides the president and the vice-presidents of the general committee: *President*—Dr. H. Strasser, professor

at the University of Bern; Dr. E. Bugnion, professor at the University of Lausanne; Dr. R. Burckhardt, professor at the University of Bâsle; Dr. H. Corning, professor at the University of Bâsle; Dr. U. Duerst, privatdocent at the University of Zürich; Dr. A. Forel, professor, Chigny; Dr. F. Sarasin, Bâsle; Dr. Sarasin, Bâsle; Dr. H. Stehlin, Bâsle.

*Committee on Finances: President*—Mr. E. Von Büren von Salis, Bern.

*Committee on Publications: President*—Dr. M. Bedot, professor at the University of Geneva.

*Committee on Receptions: President*—Dr. H. Kronecker, professor at the University of Bern.

*Committee on Lodgings*—Dr. E. Hess, professor at the University of Bern.

*Committee on Entertainments*—Dr. O. Rubeli, professor at the University of Bern.

*Committee on Refreshments*—Dr. H. Graf, professor at the University of Bern.

*Press Committee*—Dr. G. Beck, Bern.

The general meeting will take place at Bern in the Palace of Parliament, and the section sittings in the new university.

During the congress there will be an excursion to Neuchâtel and to the Zura lakes, in order to visit the lake-dwellers' settlements.

The closing session of the congress will be held at Interlaken. Afterwards, the members of the congress will be invited to visit other Swiss cities. Concerning intended communications, inquiries, etc., address the president of the Sixth International Congress, Museum of Natural History, Waisenhausstrasse, Bern.

The congress is open to all zoologists and to those interested in zoology.

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## *THE DEDICATION OF PALMER HALL, COLORADO COLLEGE.*

PALMER HALL, the new science and administration building of Colorado College, at Colorado Springs, was formally dedicated on February 23, the dedicatory address being delivered by Dr. David Starr Jordan. The new building, which cost about $280,000, is 287 feet long and 95 feet wide. Besides a subbasement six feet high, there are three stories, a basement and a first and second floor. The style of architecture is that which has been chosen for the entire system of buildings eventually to occupy the college campus, the first example of which was presented in the Coburn Library. The structure is built of the 'peach blow' sandstone of Colorado, and is fire-proof, with steel frame and concrete floors, overlaid with terazzo finish. In the basement are laboratories for chemistry, physics and psycho-physics, and a large demonstration room. On the first floor are the executive offices, general lecture rooms, other laboratories for chemistry and physics, the lecture room of the department of sociology, etc. On the second floor are the museum, and the departments of biology and geology, etc. An endowment of $50,000 has been provided for the building, and the equipment to date has cost about $30,000. These sums, of course, are wholly inadequate. The members of the staff of Colorado College (including Cutler Academy) whose work is more especially connected with science are as follows: Dr. W. F. Slocum, president and head professor of philosophy; Dr. F. Cajori, dean of the engineering school and head professor of mathematics; Dr. E. G. Lancaster, assistant professor of philosophy and pedagogy; Dr. F. H. Lond, professor of mathematics and astronomy; Professor W. Strieby, professor of chemistry and metallurgy; Mr. M. F. Coolbaugh, instructor in chemistry; Dr. E. C. Schneider, professor of biology; Dr. W. C. Sturgis, lecturer on botany; Dr. G. I. Finlay, professor of geology, mineralogy and paleontology; Dr. T. K. Urdahl, professor of political and social science; Dr. J. C. Shedd, professor of physics; Mr. F. R. Hastings, lecturer on the history of philosophy; Miss E. P. Hubbard, instructor in mathematics; Mrs. W. P. Cockerell, instructor in botany in Cutler Academy; Mr. T. D. A. Cockerell, curator of the museum.

In addition to the dedicatory exercises proper, addresses were delivered on February 22 by Dr. C. R. Van Hise, on 'Colorado as a Field for Scientific Research'; by Dr. S. L. Bigelow, on 'The Growth and Function of the Modern Laboratory'; by Dr. C. E. Bessey, on 'The Possibilities of the Botanical Laboratory,' and by Dr. Henry Crew, on 'Recent Advances in the Teaching of Physics.' In connection with the exercises, the degree of LL.D. was conferred on General William J. Palmer, in whose honor Palmer Hall was

named. General Palmer is one of the principal founders of Colorado Springs, and has probably had more to do with the upbuilding of Colorado than any other one man. He has during many years aided the college in innumerable ways, and is one of its trustees.

Colorado College does not pretend to be a university, and in fact always has insisted on the college ideal as distinguished from that of the university proper. Nevertheless Dr. Jordan, in his address, spoke the following significant words:

"I am told that Colorado College is one of those which aspires to be only a college, a thoroughly good college of course, but that she has no thought of becoming a university. I do not learn this from my friend, Dr. Slocum, and I know that his ambition is boundless. But whether it be true or not, I am going to oppose the idea. She will be a university before you know it. This Palmer Hall may be offered in evidence that the college period is past. Colorado College has already become a university. A university in embryo, perhaps, if you like, but still with all the marks by which the university is known—as certain to become a university in fact as a pine seedling on your royal hills is sure some day to become a pine tree.

"A university in America is a place where men think lofty thoughts, and where men test for themselves that which seems to be true, where men go up to the edge of things and look outward into the great unknown, where men find their life work."

And, it may be added, it appears to be universally expected and desired by those who insist upon the word college that the opening of Palmer Hall shall mark the beginning of a period of scientific research, the extent of which is only to be limited by the men and materials available.

T. D. A. C.

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### *THE STUDY OF SCIENCE.*

The secretaries of the Royal Society have submitted to the universities of the United Kingdom the following 'Statement regarding Scientific Education in Schools, drawn up by a Committee of the Royal Society':

"Notwithstanding efforts extending over more than half a century, it still remains substantially true that the public schools have devised for themselves no adequate way of assimilating into their system of education the principles and methods of science. The experience of 'modern sides' and other arrangements shows that it can hardly be expected that, without external stimulus and assistance, a type of public-school education can be evolved which, whilst retaining literary culture, will at the same time broaden it by scientific interests. On the other hand, it is admitted that many students trained in the recent foundations for technical scientific instruction have remained ignorant of essential subjects of general education.

"The bodies which can do most to promote and encourage improvement in these matters are the universities, through the influence which they are in a position to exert on secondary education. This improvement will not, however, be brought about by making the avenues to degrees in scientific or other subjects easier than at present. Rather, the test of preliminary general education is too slight already, with the result that a wide gap is often established between scientific students careless of literary form and other students ignorant of scientific method.

"It may be suggested that the universities might expand and improve their general tests, so as to make them correspond with the education, both literary and scientific, which a student, matriculating at the age of nineteen years, should be expected to have acquired; and that they should themselves make provision, in cases where this test is not satisfied, for ensuring the completion of the general education of their students, before close specialization is allowed.

"In particular, it appears desirable that some means should be found for giving a wider range of attainment to students preparing for the profession of teaching. The result of the existing system is usually to place the supreme control of a public school in the hands of a head master who has little knowledge of the scientific side of education; while the instructors in many colleges have to deal

with students who have had no training in the exact and orderly expression of their ideas.

"Our main intention is not, however, to offer detailed suggestions, but to express our belief that this question of the adaptation of secondary education to modern conditions involves problems that should not be left to individual effort, or even to public legislative control; that it is rather a subject in which the universities of the United Kingdom might be expected to lead the way and exert their powerful influence for the benefit of the nation."

## *SCIENTIFIC NOTES AND NEWS.*

BY order of its council the next meeting of the Astronomical and Astrophysical Society of America will be held in affiliation with the American Association for the Advancement of Science, at Philadelphia, during convocation week, 1904–05.

DR. ALEXANDER AGASSIZ, director of the Harvard University Museum and president of the National Academy of Sciences, has been advanced to a foreign associate of the Paris Academy of Sciences, to fill the vacancy caused by the death of Sir George Gabriel Stokes.

MCGILL UNIVERSITY has conferred the degree of LL.D. on Dr. Edward L. Trudeau of Saranac Lake, N. Y., in recognition of his work on the open-air treatment of tuberculosis, and on Mr. Edward Weston, of Newark, N. J., the investigator and inventor in electrical science.

PROFESSOR W. OSTWALD, of Leipzig, has been elected an honorary member of the Society of Scientific Men at Moscow.

THE University of Utrecht has conferred an honorary doctorate of medicine on Professor J. H. van't Hoff, of Berlin.

PROFESSOR G. H. DARWIN, of Cambridge, has been elected a foreign associate of the Belgian Academy of Sciences.

LORD KELVIN is one of three nominees for the chancelorship of the University of Glasgow.

PRESIDENT JORDAN, of Stanford University, is expected to join the *Albatross* on about April 10 to make a biological examination of Monterey Bay. Professor W. E. Ritter, of the University of California, is at present carrying on a survey of the coast between San Diego and Catalina Island, under the general direction of President Jordan.

REAR ADMIRAL GEORGE W. MELVILLE, U.S.N. (retired), and Mr. George Westinghouse arrived in Paris at the beginning of March after an extended European trip. The former is making an investigation of the extent to which turbine engines are being applied in naval construction.

PROFESSOR H. C. ERNST, of the Harvard Medical School, has recently appeared before a committee of the Massachusetts legislature in opposition to the bill to restrict animal experimentation in the state.

DURING the summer Assistant Professor J. O. Snyder, of Stanford University, will undertake for the government an examination of the rivers and streams of northwestern California, Nevada and Oregon.

DR. W. R. BRINCKERHOFF and Dr. E. E. Tozzer, of the Harvard Medical School, members of the expedition to the Philippines sent out under the direction of Dr. Councilman, have arrived in Manila.

PROFESSOR FREDERIC S. LEE, who has recently been promoted to a full professorship of physiology at Columbia University, has been granted leave of absence for the academic year of 1904–5, and will spend the time in European laboratories.

SIR DAVID GILL, director of the Royal Observatory at the Cape of Good Hope, is on a visit to Great Britain.

IT is stated in the newspapers that Professor E. P. Lewis, of the University of California, has received a grant of $500 from the Carnegie Institution to purchase prisms and lenses for the study of the spectra of gases under different physical conditions.

SIR WILLIAM HUGGINS, president of the Royal Society, celebrated his eightieth birthday on February 7.

DR. AUGUST DÖRING, titular professor of philosophy at Berlin, has celebrated his seventieth birthday.

Professor Kuno Fischer, of Heidelberg, will not retire, as has been announced, but offers this summer four lectures a week on 'The History of Modern Philosophy.'

At the instance of Professor John Marshall and Professor Edgar F. Smith, of the University of Pennsylvania, thirty-four Americans, who formerly studied chemistry at the University of Göttingen, have united to send a gift to Heinrich Mahlmann, who is celebrating his fiftieth year of service as 'Diener' in the Chemical Laboratory at Göttingen.

Dr. Henry F. Osborn, of Columbia University and the American Museum of Natural History, lectured before the Academy of Science and Art at Pittsburg in the Carnegie Institute on March 10, his subject being 'The Evolution of the Horse.'

We regret to record the deaths of Dr. Magnus Blix, professor of physiology at the University of Lund, at the age of fifty-five years; of Dr. Ludwig Beushausen, docent for geology and paleontology at the Berlin School of Mines, at the age of forty-one years, and of Professor F. S. Schmitt, director of the Natural History Museum at Stockholm.

The St. Petersburg Academy of Science has offered $3,750 for information in regard to the party of Baron Toll, the Arctic explorer, from whom nothing has been heard since he left the yacht *Zaria*, in 1902, and started for Bennett Island.

Several subscriptions are announced for the Institute of Medical Sciences, to be established under the auspices of the University of London, the largest of which is $25,000 from Mr. Alfred Beit.

The American Electrochemical Society will hold its fifth general meeting at Columbian University, Washington, D. C., on April 7, 8 and 9. The headquarters wil be at the Shoreham Hotel. The chairman of the local committee is Colonel Samuel Reber, and the chairman of the executive committee, Dr. H. W. Wiley.

The Southern Society for Philosophy and Psychology was organized on February 23 in Atlanta, Ga. Its officers are: *President,* Professor J. Mark Baldwin, Johns Hopkins University; *Secretary,* Professor Edward Franklin Buchner, University of Alabama; *Council,* the president, secretary, Dr. William T. Harris, Washington, D. C., Mr. Reuben Post Halleck, Louisville, Ky., and Professor A. Casewell Ellis, University of Texas. The aim of the organization is to promote the welfare of philosophy and psychology in southern institutions.

We are requested to state again that the Association for maintaining the American Women's Table at the Zoological Station at Naples and for promoting Scientific Research by Women announces the offer of a second prize of one thousand dollars for the best thesis written by a woman on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical or physical science. The theses offered in competition are to be presented to the executive committee of the association and must be in the hands of the chairman of the committee on the prize, Mrs. Ellen H. Richards, Massachusetts Institute of Technology, Boston, Mass., before December 31, 1904. The prize will be awarded at the annual meeting in April, 1905.

We learn from *The Observatory* that an observatory has been established at Zagreb, the capital of Croatia (Hungary), under the direction of Professor Otto Kucera. This institution, which is an offshoot of the Croatian Philosophical Society, established in 1887, aims at doing good astronomical work as well as popularizing the science in Croatia. It already possesses equatorials of 6.4 inches and 4.25 inches aperture, as well as other instruments, and with these it is proposed to observe the sun and planets, and variable and colored stars.

A parliamentary paper has been published relating to the proposed adoption of a metric system of weights and measures for use within the British empire. The London *Times* states that in a circular sent from the Colonial Office, dated December 9, 1902, the colonial governors were asked to say what action was likely to be taken in their respective colonies with regard to the resolution adopted at the

Conference of Colonial Premiers in London in favor of the adoption of a metric system. The replies received are thus summarized. The metric system is already used in Mauritius and Seychelles. The following are favorable to its adoption: Australia, New Zealand, Cape of Good Hope, Transvaal, Orange River Colony, Southern Rhodesia, Gambia, Northern Nigeria, Gibraltar, British Guiana, Trinidad, Leeward Islands, Windward Islands. Also, with a reservation that it must also be adopted in the United Kingdom or in the empire generally, Sierra Leone, Southern Nigeria, Ceylon and Falklands. Hongkong would take common action with other colonies. The states of New South Wales, Victoria and Western Australia are also favorable, but, together with South Australia and Tasmania, consider that the matter is one for the Commonwealth Government. Fiji is doubtful, but must follow Australia and New Zealand. British New Guinea would go with Australia. Jamaica and British Honduras need the adoption of the system in the United States of America. The practise of India is important to the Straits Settlements, which would be followed by Labuan; and the Bechuanaland Protectorate would follow the rest of South Africa. St. Helena, Cyprus, Lagos, Wei-hai-wei, Barbados and Bahamas are on the whole unfavorable. The Gold Coast Colony and the state of Queensland are prepared to adopt the system, but consider that inconvenience would occur. Natal can not consider the matter until some general lines of legislation have been agreed upon. No definite answer has been given by Newfoundland, Malta or Bermuda. Canada has not yet replied.

THE forthcoming annual volume of 'Mineral Resources' published by the U. S. Geological Survey will contain a report of Mr. F. H. Oliphant on the production of petroleum in 1902. Seven facts with reference to the petroleum industry of 1902 are emphasized in this report. (1) The production of crude petroleum, which amounted to 88,757,395 barrels, was greater than that of any previous year. (2) The great increase was due principally to the development of an inferior grade of petroleum in Texas, California and Louisiana. (3) There was a slight decrease in the production of the Appalachian field and a slight increase in the Lima-Indiana field, caused by the increased production in the state of Indiana. (4) The general average price paid for the crude petroleum produced was less than in any year since 1898, although the average price for the better grades produced in the Appalachian and the Lima-Indiana fields was four cents greater in 1902 than in 1901. (5) Stocks held in the Appalachian and Lima-Indiana fields showed a considerable decrease, principally in the Appalachian field. (6) The amount of refined and crude petroleum exported in 1902 was slightly less than that of 1901. There was an increase in the amount of crude petroleum and residuum exported, a decrease in illuminating petroleum, and an increase in lubricating petroleum. While the quantity of exports of all grades decreased only 1.37 per cent., the value decreased 5.62 per cent. The home consumption has been increasing more rapidly in the last three years than it did in former years. (7) No new pools were discovered in 1902. Indications point to the existence of a new source of petroleum supply in Alaska.

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## UNIVERSITY AND EDUCATIONAL NEWS.

THE College of Pharmacy of the City of New York, established in 1831, and possessing a well-equipped building on Sixty-eighth St., has become a part of Columbia University. President Butler becomes president of the college, which, however, remains a separate corporation, its finances being managed by its own board of trustees, as is the case with Teachers College and Barnard College. It is also announced that Columbia University has received an additional sum of $50,000, making $350,000 in all, for Hartley Hall, and will proceed to erect this and another dormitory on the Amsterdam side of South Field.

PRINCETON UNIVERSITY has received gifts of the value of $35,000, including $15,000 from Mr. Morris K. Jesup, to increase the endowment fund bearing his name.

Announcement is made in the *N. Y. Evening Post* in regard to the celebration of the jubilee of the University of Wisconsin, and the inauguration of President Van Hise. Wednesday, June 8, will be 'semi-centennial' day. An address of congratulation on behalf of the American universities will be delivered by Dr. Daniel C. Gilman, president of the Carnegie Institution. The universities of the far west, the south and the middle west will be represented respectively by President Benjamin Ide Wheeler, of the University of California, President R. H. Jesse, of the University of Missouri, and President Cyrus Northrop, of the University of Minnesota. President James B. Angell, of the University of Michigan, will deliver an address on the function of the State University. The inauguration of the president, Charles R. Van Hise, the eminent geologist, will occur on Tuesday, June 7. President William R. Harper of Chicago University will present the greetings of other American universities. Governor La Follette, a classmate of Dr. Van Hise, will welcome him to the presidency, and Professor Frederick J. Turner, '84, will respond on the part of the faculty. The state superintendent of public instruction, Mr. Cary, will make an address on the western educational system, which makes the state university the crown of the public school system.

A cablegram to daily papers states that the University of Vienna has been closed in consequence of threats of disturbances among the students. The German students were much incensed at the demonstrations of the Czechs against their German comrades at Prague, Bohemia, and threatened retaliation.

A scholarship valued at $150.00 has recently been established in the New Mexico School of Mines, open to the best member of the graduating class of each year, desiring to make a special study of mining machinery in the large manufacturing works.

Dr. Andrew S. Draper has resigned the presidency of the University of Illinois to become commissioner of education of New York State. This is a result of the unification bill which was signed by Governor Odell on March 8. Under the new organization the eleven regents and their terms of office are as follows: Whitelaw Reid, nine years; Edward Lauterbach, seven years; Eugene A. Philbin, five years; Charles A. Gardner, six years; St. Clair McKelway, two years; Dr. Albert Vander Veer, one year; Charles S. Francis, eleven years; William Nottingham, three years; Daniel Beach, four years; Pliny T. Sexton, ten years; T. Guilford Smith, eight years.

Professor Frank Thilly, of the University of Missouri, has been elected to the Stuart chair of psychology at Princeton University, vacant by the removal of Professor J. Mark Baldwin to the Johns Hopkins University.

Owing to the continued illness of Professor John Krom Rees, of Columbia University, he will be absent with leave for the year 1904–5. The trustees have made Adjunct Professor Harold Jacoby professor and acting head of the department of astronomy during Professor Rees's absence. Charles L. Poor, Ph.D., formerly assistant professor of astronomy in the Johns Hopkins University, is also made professor of astronomy. The following adjunct professors have been promoted to professorships: Frederic S. Lee, Ph.D., to be professor of physiology; Edmund H. Miller, Ph.D., to be professor of analytical chemistry; Marston T. Bogert, Ph.D., to be professor of organic chemistry; Bashford Dean, Ph.D., to be professor of vertebrate zoology; Cary N. Calkins, Ph.D., to be professor of zoology, and H. E. Crampton, Ph.D., to be professor of zoology at Barnard College. The following instructors have been made adjunct professors: Eugene Hodenpyl, M.D., in pathological anatomy; Francis C. Wood, M.D., in clinical pathology; Frederick R. Bailey, M.D., in normal histology; Lea McI. Luquer, Ph.D., in mineralogy; and Bradley Stoughton, B.S., in metallurgy.

Dr. Th. Ziehen, of Halle, has been called to the chair of psychiatry at Berlin vacated by the death of Dr. F. Jolly.

The Isaac Newton studentship at Cambridge University, of the value of £250, for study and research in astronomy has been awarded to Zia Uddin Ahmad, B.A., of Trinity College.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 25, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *RECENT ADVANCES IN THE TEACHING OF PHYSICS.**

THIS is an hour when anything but congratulation is impossible, not alone for this queenly city seated at the foot of the majestic Front Range, but for the entire commonwealth. The foresight as well as the generosity of the donor in aiding an institution which had already richly deserved such aid, the skill and taste of the architect, the adaptation of the laboratories to the needs of modern science, these all command our admiration. The manner in which a quarter of a century has transformed a mountain foothill into an educational center challenges the respect of every one.

From a sister university on the eastern slope of the Mississippi I bring to your president and to his staff greetings and all good wishes. I bring them no reminder of the responsibility which always accompanies opportunity such as is represented by this building, for there is probably, in all the land, no group of men more keenly aware of the fact that endowment and duty are close friends. No one knows better than the men who have this work in hand that not to advance is to recede.

Times are not so simple as they were even twenty-five years ago, and we are finding ourselves daily more and more in the position of the red queen in the Alice books where 'it takes all the running you can do to keep in the same place.'

* Paper read before the Science Conference held at the dedication of Palmer Hall, Colorado College, February 22, 1904.

But change does not always spell advance, and not every novelty is an improvement. It may be well, therefore, before we consider progress along any particular line, to recall what constitutes progress in general. The profound studies of Mr. Spencer led him to a very happy definition of progress, namely, 'an increase in the adaptation of man to his environment.' This description would be eminently satisfactory were it not that in another place Mr. Spencer characterizes progress as a 'benevolent necessity,' thus robbing it of every element of human initiative and of conscious endeavor. For this reason many of Mr. Spencer's most ardent admirers—among whom I count myself—while admitting the happiness of his phrasing, will nevertheless prefer the view of Professor Karl Pearson who regards progress as the result of a distinct program, the outcome of plans laid with care and according to the soundest biological principles.

Having in mind this point of view from which progress is a consequence of deliberate forethought, I invite your attention to some of the advances recently made in the teaching of physics to English-speaking students.

Let us use the word 'recently' as referring to the last thirty years and consider *first* some advances in the *teaching* of physics which have resulted from advances in the *science* of physics.

### I. IMPROVEMENTS IN MATERIAL.

The purchase by Princeton College of one of the Gramme machines exhibited at the Centennial Exposition in 1876 may, perhaps, be fairly considered as marking the introduction of the modern dynamo into the American physical laboratory. Only five years after this date I found myself a student in this laboratory which had purchased the Gramme machine—an excellently equipped and ably directed laboratory, then as now. A single illustration must suffice to show how matters have changed. On turning the pages of my first-year note-book, I find that one of the experiments assigned me was the measurement of the current furnished by this Gramme machine under certain definite conditions. This was done in two ways: (1) the earth's horizontal magnetic component was determined at a certain point; at this particular point was placed a tangent galvanometer whose constant I had computed; the deflection which the current produced in this instrument completed the data necessary to determine the current in webers. Amperes were yet novelties, not to say mysteries. The graded galvanometer and the ampere-balance of Kelvin were not yet on the market. The beautiful instruments of Weston were unknown. (2) The second method employed was to assume the electro-chemical equivalent of copper and proceed to measure the average current by weighing the amount of metal which it had deposited.

Each of these processes proved highly instructive, and they are cited merely to show the amount of time and detail which the student was driven to consume when for any reason he wished to know the value of the current he was using; for the 'working constant' of the galvanometer carried about the laboratory was by no means so constant as its name might imply.

Another forward step was marked by the introduction of the low-resistance, portable D'Arsonval galvanometer which permits the elementary student, at his own laboratory table, to study practically all the fundamental properties of electric currents; this with an outfit which is simplicity itself, and at a cost which brings the entire equipment easily within the range of the most modest high school. The point here, let me insist, is not the increased convenience and comfort of the student,

but rather the power which it confers upon him of devoting his energies to those phases of the subject which are under investigation, those topics which for the time being have become really fundamental.

Among other improvements in this direction there came after the dynamo, in rapid succession, like a host of beneficent corollaries, the electric motor, the arc lamp, the incandescent lamp, the storage cell, the powerful magnetic field, the transformer, the electric furnace, the electrolytic interrupter, the oscillograph, each opening up hitherto-undreamed-of possibilities in the way of demonstration for elementary students and of investigation for advanced students.

I shall not detain you further to illustrate a point which is, perhaps, more familiar to many of you than to me. Let me only mention, as opening up new possibilities for the student, the platinum thermometer, the high temperature mercury thermometer, the Rowland grating, the Wallace-Thorpe replica, the interferometer, Jena optical glass, quartz ware, the cheap production of aluminium, platinum mirrors, isochromatic dry plates, and so on almost without end.

But if these devices have aided undergraduate instruction, what shall we say of the student advanced to the point where he is ready to take up a piece of research? For him they have rendered problems soluble, by the hundred, which previously lay in the region denoted by Mr. Gladstone as 'outside of practical politics.'

But best of all the discoveries which the last generation has made concerning the merely mechanical side of teaching physics is the fact that practically all the fundamental—and many even of the more recondite—principles may be demonstrated with apparatus of the utmost simplicity. One condition only stands between the simple material outfit and success, namely, an instructor who is so thoroughly master of the subject and of the situation that he will see that the student gets from his outfit all the information and all the training intended. The older any man becomes, the more he admires simplicity, and especially the simplicity of nature (our ever-present model), of whom Fresnel remarked: 'She never balks at the difficulties of analysis, but always hesitates to employ methods which are complicated.'

The nations of light and leading have made a capital discovery just at the close of the nineteenth century; they have just awakened to the fact that they can 'go in and possess the land' more easily when they have at home an intelligent rank and file, an educated parliament, a scientific government, a free and happy electorate. So also in the teaching of physics a capital discovery has, I think, been recently made in the fact that armament is not everything. No number of expensive and elaborate demonstrations, no striking exhibitions of machinery can ever replace the simple experiment, the lucid and orderly presentation of phenomena, the distinct effort made by the student to grasp the essential principle, or the conscious effort at accurate observation and judgment called forth by an ambition to get from a simple device the best attainable result and the simplest possible point of view. There is danger in any instrument when it becomes so perfect and so accurate that the young man who is working with it is tempted to degenerate into an 'organ-grinder.' The accuracy in a laboratory should not all be confined to its machinery; some should be left for the judgment.

It was, therefore, no small step in advance when the instructor came to see clearly that all he can ask of a piece of apparatus is that it shall be capable of yielding the results which he demands of the student, and conversely that he can

not hope to train the student in habits of precise thinking without demanding of him nearly the best which the apparatus can give.

With such an undoubted improvement as the advent of the student laboratory, it was inevitable that some enthusiastic admirers should push it too far. In the earlier days mistakes were undoubtedly made in thinking that if once a laboratory could be established and once the student gotten into it, his scientific salvation was immediately insured, if not, indeed, already accomplished.

But now the pendulum has swung back; the days of 'organ grinding' in the laboratory have largely ceased, and I reckon it not least among recent advances in the teaching of physics that the modern instructor has learned that an undergraduate can not be simply turned loose in a laboratory. Much forethought, indeed, is demanded in order that during laboratory hours the instructor may keep quiet and the student keep busy—and keep busy not on any haphazard problem, but keep busy on a *series* of problems so graded that, by solving them in order up to any point, he has developed the power of intelligently undertaking the next. Carefully planned courses of this kind are to be found in many laboratories, every one of them a powerful aid toward putting a young man into a position where he always 'knows what to do next,' which, as President Jordan has admirably remarked, constitutes a liberal education.

II. IMPROVEMENTS IN METHODS.

1. *Introduction of the Energy Treatment.*—Leaving now to one side all questions of material outfit, let us consider some improvements of a still more fundamental nature. I refer to those which have been made in the *method* of teaching. Here it is scarcely possible to believe the changes which a single generation has wrought.

Progress is something to which the Anglo-Saxon takes so kindly that he is apt to forget just what manner of man he was some thirty years ago.

Perhaps I can most briefly illustrate by reading a few lines from Tait's review of Balfour Stewart's 'Lessons in Elementary Physics.' Stewart, as many of you know, was one of the first men to treat physics as a single subject—to treat heat, light, sound and mechanics from the energy point of view—the view which, twenty years before, had, as we now believe, been thoroughly established by Joule, Helmholtz and Kelvin. This review was published in *Nature* December 29, 1870. Here is what Tait says: "This is a bold experiment and decidedly deserves to be a successful one. * * * It is scarcely possible to form a judgment as to the probable success of the present work. It is so utterly unlike anything to which we have been accustomed that we can only say that we never saw such a work in English at least. * * * The reign of inartificiality and simplicity must soon be inaugurated and this work will greatly tend to hasten its advent."

These are the remarks of an experienced teacher and able investigator concerning a text-book which to-day we all recognize as eminently natural and simple. So familiar are we with the energy treatment that we are apt to forget how recently these 'water-tight compartments' existed in physics as they yet do, according to the gospel of John Perry, in the department of mathematics.

But, after all, the energy view-point is merely the outcome of the Lagrangian dynamics and Helmholtz's little tract on the 'Conservation of Energy.' Trowbridge's 'New Physics,' appearing some twenty years ago, did excellent service in furthering this standpoint.

The introduction of the energy idea did

more than merely unify the subject; it placed in the hands of the teacher the possibility of making a really simple and logically-arranged presentation of his subject, a presentation which had been in vogue among the classicists for many years, and possibly the only presentation which could make the experimental study of physics a genuine training for power.

In the domain of higher physics, the work of J. J. Thomson, in 1887, on the 'Application of Dynamics to Physics and Chemistry' may fairly be considered as marking an epoch in the energy treatment and in the unification of physical science. Equally impressive are the three volumes containing the proceedings of the International Congress of Physicists at Paris in 1900. One turns the entire two thousand pages of this report without feeling the slightest discontinuity either of subject or of method, from the dynamical papers at the beginning to the electrical papers at the end.

2. *Introduction of the Student Laboratory.*—But of all reforms in method the most revolutionary was the introduction of the student laboratory, which came in at about the same time with the energy treatment.

To be sure, especially favored students have always been admitted to the private workshop of the master, but it is only within the last generation that *students in general* have obtained similar privileges.

In a letter to *Nature,* dated January, 1871, Professor E. C. Pickering describes the new physical laboratory of the Massachusetts Institute of Technology, where he was then an instructor, and proceeds to add: 'There are now in America at least four similar laboratories either in operation or in preparation and the chances are that in a few years this number will be greatly increased.'

How amply this prediction has been fulfilled may be realized when we consider that America has to-day more nearly four hundred fairly equipped physical laboratories.

In this connection it is well for those of us who are inclined to be optimistic to turn now and then to Professor Pickering's 'Physical Manipulation,' the only English laboratory manual available in my undergraduate days, and see how thoroughly modern his treatment remains. Confessedly the problems are not graded exactly as we should do it to-day, yet in spirit, in method, in economy of teaching energy and in sound learning these two volumes may well give us pause, and make even the most sanguine ask whether evolution is not a provokingly tedious process.

Let no one infer, however, that improvements in method are entirely illusory, for the present-day instructor in physics certainly has in mind more clearly than any before him just what the goal is and just what the method of approach. He knows full well that no student can work out his own salvation while seated in a comfortable auditorium chair, observing a speaker manipulate certain curious apparatus with certain curious effects.

3. *Lessons Learned from the Engineer.* —The modern instructor has learned also to take advice from the engineer—this too without bowing to the immediately useful and without substituting mere knowledge for intellectual power. He realizes that centrifugal forces, centrifugal couples and the energy of rotation may quite as well be studied from bicycles and the driving wheels of a locomotive as from an ellipsoid strung on a knitting needle. Electrical *science* and electrical *engineering* were at one time much farther apart than they are to-day; the engineer and the physicist are closer friends than they were twenty-five years ago.

Perhaps neither all the phariseeism nor all the charity has been confined to one

side. America's two leading physicists were each educated in engineering schools, the one at Troy, the other at Annapolis.

Helmholtz says: 'Action alone gives a man a life worth living, and, therefore, he must aim either at the practical application of his knowledge or at the extension of the limits of science itself.'

Here we have, at once, the justification of the engineer and of the investigator—a view which has, I believe, been accepted by many instructors greatly to the advantage of their method.

Briefly, then, the marked improvements in method have been: (1) The introduction of the energy viewpoint, thus securing unity and simplicity of treatment; (2) the introduction of the student laboratory, and (3) the introduction of more concreteness; this last being a beneficent reflex influence from the engineering side.

### III. MEN.

Passing now to the men who have been and are teaching physics in America, the word 'progress' raises a difficult and almost insoluble problem. At any rate, I shall asume that we *all* agree in putting the main emphasis upon the spirit and ability of the instructor. The fundamental difference between laboratories is, indeed, after all a difference between men. What they call at Berlin 'die Glanz-periode der exakten Wissenschaften'—the years immediately following the Franco-Prussian war—was essentially the product of four or five men, Virchow, du Bois-Reymond, Hofmann, Kirchhoff and Helmholtz.

I may as well at the outset confess myself a hero worshiper and say that my respect for the university instructors of the preceding generation—some of whom I met during nine years at Princeton, Berlin and Baltimore—is so nearly unbounded that I dare not think the talent engaged in teaching physics to-day is, in any important respect, superior to that of the recent past.

When, however, we turn to the average college instructor or to the average high school instructor it becomes patent that the entire situation has changed. Recent developments in physical science and the duplication of instructors have driven men to specialize. As Professor Runge once said to a meeting of astrophysicists at the Yerkes Observatory: 'Nature is becoming more and more disorderly every day!' The young teacher without special training navigates uneasily a stream beset with small craft hailing him for information about the trolley line, about the automatic telephone, about the transformer, about liquid air, about radium.

The modern instructor in physics—and I dare say the same change has occurred in other sciences—is first of all a man who has shown his ability to widen the borders of human knowledge. Power to investigate is becoming more and more a first criterion for his ability to teach. (Shortly it will be a necessary criterion.) In any event he is a man who has an intelligent interest in and an active sympathy with physical research.

In the *second* place, he is a man with a keen Greek perception of relative values, a cultivated sense of proportion, always subordinating mere facts to methods, always placing the power of clear thought above any amount of mere knowledge.

Again he is frank and fearless in the confession of ignorance, but only after he has made every effort to bring this ignorance to a minimum.

The modern instructor does not trifle with atoms, molecules and other hypothetical creatures which he has not seen and does not know about. He takes pains to point out the line of demarcation between the known and the unknown, believing that few things are more instructive for

the learner than the limitations of human knowledge concerning even household matters. As a boy I was taught to respect Newton as the man who had explained gravitation; to-day the lad is taught that Newton distinctly refused even to make a guess at its explanation. With equal piety, I was taught that there are six kinds of electricity, all mysterious and imperfectly understood; but it was never hinted in those days that we are no less ignorant of what carbon or what copper is than we are as to the nature of electricity.

Illustrating this point, I have long maintained that one of the most scholarly men I ever met was a motorman on a trolley line running out of Denver some thirteen years ago. I was at the time visiting the then new University of Denver. And seeing what appeared to me an *extra* wire suspended above the trolley, I stepped to the forward end of the car and inquired as to its purpose. I shall never forget the reply of the man as he turned his frank countenance toward me and said: 'My dear sir, all I know about this is just enough to turn on the juice and let her buzz!'

Still again the instructor in modern physics is a man who believes in the careful scrutiny of all the data which enter into an argument, and in the avoidance of reasoning from insufficient data—the 'bastard *a priori* method' as described by Spencer. The modern laboratory instructor is a man whose ambition for his student is that in the presence of physical phenomena he shall maintain a certain mental attitude of independence, a habit of observation, inquiry, experiment and judgment, that he shall acquire what is known in military circles as skill in scouting.

The difficulty of these tasks was not first pointed out either by Longfellow or by Goethe; for Hippocrates* had already remarked that: 'Art is long, time is fleeting, opportunity brief, experiment difficult, judgment uncertain.'

*'Aphorisms,' T. I.

In conclusion we find that improvements in the teaching of physics have come from three directions, improvements in *material*, improvements in *method* and improvements in *men*. But unfortunately the greatest changes appear to have occurred in the least important direction, namely, that of material; while the least change is visible in the most important direction, namely, in the teaching staff.

So much for the past, but what of the future? The physical and biological sciences have changed the entire face of civilization; they have ameliorated human suffering, they have prevented disease, they have set us free from a thousand and one painful superstitions. Does any one imagine their career at an end? The fact appears to be that in the immediate future these sciences are to become the determining factor in deciding the superiority of nations. Numbers are a *potent* factor, but they are not everything. What a host of phenomena in the South African War are explained by the incident of the Boer father who handed his boy a single cartridge and instructed him to go out and bring in an antelope!

Two duties would, therefore, appear to thrust themselves upon every instructor, every investigator and every patron of science. The first is to see that science is taught in a still more effective manner. The test of effectiveness we must find in the students' ability to *do* something; he must either help us to use the energies of nature to make life easier or he must join the pioneer corps and show us new properties of matter and energy whose usefulness no one to-day will question.

And secondly we who have faith in the scientific method must exhibit the courage of our convictions in seeing that science

becomes the handmaid, or better still the adviser, of the state.

More than a quarter of a century ago it became evident that stone fortifications are worse than useless in the presence of modern armaments; but as a people we have yet to learn that the stone building which is about to be dedicated is one of the bulwarks of the nation. The executive branch of our government has learned it partially; the legislative branch not at all. I look forward with hope—and even confidence—to the day when science will be in in the saddle, not for science's sake so much as for America's sake.

And it is precisely in Palmer Hall that young men and young women are going to learn that accuracy of speech and thought which is at once the first step in morality and the best preparation for action. *Here, if anywhere,* will be acquired productive scholarship.

Could we have with us the man whose life and character is celebrated to-day throughout this broad land no one would be more enthusiastic than he in applauding the purposes of this institution and in acknowledging our national indebtedness to this and to similar foundations.

Upon the teacher of science, perhaps, above all others falls the duty of insisting with Lotze that 'while the scientific method may not be the royal road to salvation it will at least keep us from straying very far from the path.'

And when on the morrow Old Glory is raised above this beautiful structure let us salute her as marking one of our national defenses.

Henry Crew.
Northwestern University.

### THE SCIENCE OF SMOKE PREVENTION.

Perhaps a better statement of the subject would be 'The Science of Perfect Combustion,' for perfect combustion is attended by no visible smoke. It is always best in a discussion of this kind to define terms before making statements. The Century Dictionary says that smoke is 'the exhalation, visible vapor, or material that escapes or is expelled from a burning substance during combustion' while the Encyclopedia Britannica states that 'Usually the name smoke is applied to this vaporous mixture discharged from a chimney only when it contains a sufficient amount of finely divided carbon to render it dark-colored and distinctly visible.' For us who live in the soft-coal belt the definition may be further narrowed down, for when we say smoke we mean the densely-laden fumes from the combustion of soft coal which deposit thick layers of soot on all exposed surfaces. The smoke from hard coal, coke and wood is so innocuous compared with that just mentioned that it may be entirely disregarded in the discussion.

The occasional production of dense black smoke is peculiar to that group of fuels known as hydrocarbons, of which the more common are the petroleums and bituminous coal. The combustion of hydrocarbons seems to be always complete at first. If one watches the slow burning of a lump of cannel in the open grate he will see a whitish or yellowish vapor expelled from the coal by the gradual heat of the fire. This is the carbon and hydrogen combined which is distilled by the heat and leaves behind the free carbon as coke. While the escape of this vapor unburned represents a distinct loss of heat, the vapor is not smoke as we understand it. It does not deposit soot and will not stain or disfigure surfaces in its path.

As the heat increases and air is supplied the vapor ignites and burns with a yellow flame showing the presence of solid particles. If the temperature remains high and the air supply continues, the combustion is complete and the colorless carbon dioxide and water vapor pass up the chim-

ney. If, however, the burning gas becomes chilled by contact with the relatively cool bricks of the chimney back or if insufficient air is supplied, the yellow flame becomes red and dingy, while particles of finely divided carbon are deposited on the adjacent surfaces or whirled away up the chimney.

The ordinary coal-oil lamp is one of the best illustrations of perfect combustion and consequent smoke prevention. The heated gases rising in the chimney produce a draft, and fresh air is continually drawn in at the bottom through the hot gauze, which warms and divides it so as to insure thorough mixing with the gases from the burning oil. Turn up the wick and the flame becomes smoky—too much hydrocarbon for the air supply. Raise the chimney slightly from the bottom and again there is smoke —too much air at too low a temperature, which chills the flame. Insert a cool metal rod into the chimney and soot is deposited on it—chilling of the flame again and disengagement of the carbon, while the hydrogen continues to burn.

And thus we may learn of the three requisites for good combustion; enough air, a sustained high temperature and a thorough mixing of the gases. The last two are so important that it is entirely possible to have an excessive supply of air and dense black smoke at the same time.

Having thus decided upon the conditions which promote good combustion and prevent smoke, it remains to determine how they may be realized in practise.

It may be said at the outset that it is entirely possible for a good fireman with his shovel, a pile of soft coal and an ordinary flat grate, to so fire a furnace as to make practically no smoke. It may also be said that this is highly improbable and that such a man would command higher wages than are usually paid to firemen.

The best method of hand firing consists in first maintaining as uniform a rate of combustion as possible by putting on coal often and in small quantities; and secondly by varying the air supply to suit any lack of uniformity which may exist. This is known as the one-shovel system of firing and has been successfully used on many of the leading railroads as a means of saving coal and reducing smoke. The nation which shortens its swords lengthens its boundaries and the railroad which shortens its coal-scoops lengthens its mileage per ton. The air supply is usually varied by leaving the door slightly ajar just after coal is put on and then closing it when the coal begins to glow. Several automatic appliances for doing this have been invented and in numerous instances have given good results. The usual plan is to have the device operated by the opening of the fire door at the time of firing.

When the door is opened some simple combination of levers and chains raises the piston of a dash-pot, which in turn lifts a flap in the door itself and opens the valve in a steam-pipe connecting with a system of steam-jets over the door. After the door is closed the flap in the door remains open and so do the steam-jets. The draft created by the latter assists to draw in additional air and the steam mixes it thoroughly with the burning gases. The jets should be directed to the back of the fire near the bridge wall. All this time the plunger of the dash-pot is slowly settling down, dropping the air damper and closing the steam-valve until at the instant when the fresh coal becomes incandescent the air supply is shut off. If the apparatus is made to operate a check-draft in the uptake at the same time the efficiency will be still more improved.

The efficiency of such an arrangement can be clearly represented by diagrams, one showing a cloud of black smoke just as it is cut off by the apparatus being thrown

into gear, while in another are shown the one chimney where the smoke preventer is in use and the three where it is not, about one minute after heavy firing.

The writer has experimented somewhat with air jets maintained by a blower and operated by a dash-pot, but the effect was not so good as when steam-jets were used. When the jets are used intermittently in the manner indicated the waste of steam is small, not over two or three per cent., while the saving in coal is frequently fifteen per cent. Any attempt to solve the problem by admitting a constant additional supply of air through the bridge or side walls has been and will be a failure, since the air supply must be varied as the demand varies.

Hand firing is at best a crude and unsatisfactory method and is gradually being superseded by mechanical means of feeding the coal to the furnace. Mechanical stokers, as they are now called, have two great advantages over hand firing: (1) The uniformity of coal feed which allows a uniformity also in the air supply; and (2) the fact that it is no longer necessary to open the door. Add to these the saving of hand labor and the possibility of handling the coal mechanically from car to furnace, and you have a good argument for the new way.

All mechanical stokers, whether inclined grate, underfeed or chain grate, are intended to feed the coal steadily and uniformly at a speed proportionate to the demand for steam, and by thus maintaining a constant rate of combustion to simplify the problem of air supply. There are at the present time at least ten different makes of stokers which are capable, when properly cared for, of maintaining this uniform combustion in such a way as to prevent smoke and save fuel. Of course somewhat extravagant claims have been made by manufacturers and agents with regard to the economy of these machines. Speaking in a guarded and conservative way, it is safe to say that any of the stokers above referred to can show a saving of from ten to fifteen per cent. over the results of ordinary hand firing.

Perhaps one of the most common causes of smoke is the overcrowding of the boilers. As the amount of work done in a factory gradually increases, new machines are added, more shafting and pulleys purchased, perhaps under pressure from the engineer a new engine is installed. The boiler plant is usually the last to receive attention, although all this time it has been suffering from overload. A boiler gives the best efficiency when worked up to or slightly over its rating; any further crowding will result in smoky fires and waste of fuel. The writer recalls one instance of this kind where an analysis of the ash showed fifty per cent. of free carbon.

Although mechanical stokers will sometimes increase the capacity of boilers, they are liable to overcrowding as well as the flat grate. This results in fires which are too heavy to be successfully handled and in a loss of economy. Overcrowding also increases the repair bill on both furnace and boiler and is on the whole an expensive experiment.

Cleaning fires is another common cause of black smoke, in most cases without excuse. A careful and skilful fireman can keep his fires clean and bright whether on flat grates or mechanical stokers, without any great disturbance of running conditions. Many firemen do not, either because they do not know or because they do not care. The writer has seen a fireman so completely uproot and tear in pieces his fire in cleaning as to necessitate almost a rebuilding. On the other hand, he has seen a skilful man so clean fires on stokers in an efficiency test where the boilers were being crowded to their utmost, that there

was practically no drop in pressure and no perceptible checking of the combustion.

Unskilled and underpaid firemen are responsible for a great deal of the poor economy and the black smoke of our boiler furnaces.

Of the efficiency of mechanical stokers in preventing black smoke there can be no doubt in the mind of any one who has seen them in operation side by side with the old type of hand-fired flat grates.

Their economy can be estimated from the following figures, which are the result not of isolated tests, but of a careful observation covering a period of years. The average rate of evaporation with hand-fired Ohio or Pittsburg bituminous slack is from five to six pounds of water per pound of coal under actual conditions. With mechanical stokers the average rate is from seven to eight pounds of water per pound of coal, and more than this has been obtained under test conditions.

A saving of from 15 to 30 per cent. may be expected from the use of mechanical stokers, and if the cost of steam to run the machine be estimated at 5 per cent. (a liberal allowance) there is left a very comfortable margin.

As the writer is no longer connected with any city government and can not be accused of any warping of judgment, he has no hesitation in saying that he considers the chain grate, as made by the Babcock & Wilcox Co., the Green Engineering Co. and others, as being the most successful solution of the problem of burning soft coal economically and without smoke, so far presented.

The uniform thickness of fire, the steady feed under the boiler and the automatic cleaning are the salient features in an apparatus which is much better than any stoker yet invented.

If one could have a picture of Newburg, that smoky suburb of Cleveland, as it was five years ago, and then again as it is today and as it will be a year from now, when the transition from hand firing to chain grates shall have been entirely completed, there would be no need of any argument on this score.

There is more than one phase in the science of smoke prevention. So far we have considered the strictly mechanical side. There are also the ethical and the legal sides to be considered. Grant that smoke can be prevented, how shall we insure that it will be, without trenching on those rights which every American citizen claims as his? Ethically considered, every one has a right to as much smoke as he wants, so long as he does not incommode or injure his neighbors.

The damage to property and to health from soft-coal smoke is now so generally conceded that no argument on this point is necessary. In other words, the man who allows black smoke to issue from his chimney is guilty of maintaining a nuisance as much as he who allows garbage or foul water to accumulate on his premises.

To quote from the ordinances of the city of Cleveland:

Sec. 2. That the owner, agent, lessee or occupant of any building or structure of any description from the smoke-stack or chimney of which there shall issue or be emitted such dense or black or gray smoke within the corporate limits of the city of Cleveland, shall be deemed and held to be guilty of creating a public nuisance, and of violating the provisions of this ordinance.

The fact once established by law and precedent that smoke production is a nuisance and that smoke producers may be fined like other law-breakers, it would seem to be a comparatively easy matter to control the evil. Experience has shown that this is not the case and that very few convictions have been made under the law.

The first step that should be taken to regulate smoke production is to make it

incumbent on the owner or builder of every new establishment, where soft coal is to be burned, to install the proper apparatus for burning it smokelessly. It should be necessary for such owner or builder to obtain a permit for setting boilers or furnaces, contingent on proper compliance with the laws regarding smoke abatement, just as it should be necessary to obtain a permit for erecting a building in compliance with the laws concerning safety against fire and accident. This provision is not a hardship and it inures as much to the benefit of the owner as to that of the public.

If every new furnace is thus set in a proper manner and is under the inspection of the proper officers, a rapid improvement will take place. The old will in the nature of things disappear; it is the new which must be the more carefully watched.

In dealing with establishments where smoke is already in evidence both moral and legal suasion must be employed; the former when it will serve, the latter as a final resort. Once convince a man that coal will be saved when smoke is stopped, and the battle is half won. The writer has a record of scores of such bloodless victories.

Before very much can be said to an offender it is necessary to prove to him that he is an offender, and this can only be done by systematic observation covering some little period of time. Whatever system is adopted, the ratings of the various stacks will depend largely on the judgment of the observer and smoke charts are an unnecessary incumbrance. Readings taken at intervals of three or five minutes for several hours, with a grading from one to four in the scale of blackness, will give a fair relative showing for the various chimneys observed and furnish a basis for arguments with the various proprietors.

An observer who has had experience can rate twenty to thirty chimneys in this way from a convenient vantage point. If 4 is taken as dense black smoke and 0 as absence of smoke, a two-hour series of five-minute readings, or twenty-five in all, will give the percentage directly by summation. These two-hour sets can be repeated at different times of day so as to cover the whole period of daylight. In this way the inspector soon becomes thoroughly familiar with each district and knows all the black sheep. A fair comparison made from such ratings will often shame the offenders into better performance.

In rating locomotives a different method must be adopted, as the time of observation is rarely over two or three minutes. For this work a graphic log has been found most reliable. Heavy horizontal lines represent per cent. of black smoke, while vertical rulings represent time intervals, usually from three to five minutes each. The observer counts regularly as he watches the stack and puts down at each interval of time a dot on one of the horizontal lines corresponding with the smoke at that instant. A line drawn through these dots shows plainly the variation in conditions. The other data are filled in as far as they can be ascertained and a copy of this report (made in duplicate by the use of carbon paper) is sent to the proper official of the road immediately. This makes a record which is rarely disputed by the engineer or fireman.

This system as applied in Cleveland had the immediate effect of reducing the smoke from locomotives to less than half the former amount as a result of improved firing, and there has been steady improvement ever since.

In dealing with the smoke problem where the evil already has a firm foothold it is necessary to institute at first an educational campaign, showing the conditions as they exist, the possibility of betterment and the resulting economy. Most smoke-producers are intelligent and reasonable men and will

listen to such arguments and will endeavor to effect improvements.

When such methods fail and the parties interested are obdurate, legal methods should be used. The law or ordinance must be carefully drawn and subjected to the best legal criticism before it is tried. 'It is better never to have sued than to have sued and lost.' But if the ordinance does fail, one has profited by experience and the next ordinance will be stronger.

To sum up the facts and conditions as they have been outlined in this paper it may be said:

(1) That objectionable smoke from soft coal can readily be prevented; (2) that such prevention will result in a higher efficiency and smaller fuel bills; (3) that all new plants should be subject to permits issued by proper city officials; (4) that educational and legal measures combined should be used in cases where the evil already exists; (5) that the control of such work should be in the hands of properly trained engineers who understand the whole subject thoroughly; (6) that the people of each community must see to it that they are protected from this evil as from poor drainage and dirty streets.

CHAS. H. BENJAMIN.
CASE SCHOOL OF APPLIED SCIENCE,
CLEVELAND, OHIO,
December 15, 1903.

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## THE CARDINAL PRINCIPLES OF ECOLOGY.*

WITHIN recent years that old phase of natural history which is concerned with the adaptations of organisms to their environment has become segregated into a distinct department of study under the name of ecology (œcology, biologie). This separation is unnatural, but it is expedient, and it is likely to result in great advances towards that most important, difficult and alluring of scientific ends, the explanation of the raisons d'etre in organic nature.

As now studied by botanists, ecology is concerned mostly with that synthetic phase of the subject dealing with the interpretation of the physiognomy of vegetation, while comparatively little is being done in the analytic phases which investigate particular features, or elements, of adaptation. To such an extent is this the case, in this country at least, that we are accustomed to use the word 'ecology' as a synonym for 'ecology of the vegetation' or 'ecological plant-geography,' a somewhat misleading usage which has been, with some justice, censured. Criticism of the use of the name, however, is of slight account in comparison with the current criticism, unpublished but wide-spread, of the methods of the subject as followed among us. Such criticism arises in part from that ubiquitous human failing which leads us to exalt our own lines of work by invidious reflections upon other lines which we do not, or will not, understand; but it is in large part deserved. Ecological publications in America are too often characterized by a vast prolixity in comparison with their real additions to knowledge, by a pretentiousness of statement and terminology unjustified by their real merits, and by a weakness of logic deserving the disrespect they receive. The subject suffers, I fear, from a phase of the 'get-rich-quick' spirit. These opinions I can express with the better grace when I hasten to admit that, so far as my own few publications are concerned, I am one of the chief of sinners. I believe it is a fact that, despite our numerous ecological publications, the only material advances made in ecology in this country for some years past are in descriptions of vegetation, in which a considerable body of fact has been accumulated. But in interpretation, the very soul of ecology, we have done little

* Read before the Society for Plant Morphology and Physiology at its Philadelphia meeting, December 29, 1903.

else than continue to kaleidoscope the old and familiar matter. Yet the aim of ecology is perfectly definite, and as lofty as any in science, being nothing less than to explain why each plant is what it is, where it is and in the company it is. Why then do we fall so far behind our ideal? The reason is perfectly plain. We have reached, and long since, the point at which, with our purely observational methods, the law of diminishing return applies strongly to the investigation of the subject; and further substantial advance is now possible only through the aid of some new method. Further, the nature of this new method is equally plain, and it is only practical limitations of time and cost which keep us from utilizing it. It lies in the precise experimental study of the physics of the environment, and of the physiological life histories of particular plants, with the invention of a mode of recording the results in a form to permit the one to be correlated with the other. There must go along with this an improvement in our ecological reasoning; or rather, to be correct, real reasoning, involving logical proof, must be substituted for those speculative yokings of conspicuous effects with prominent possible causes which too often take the place of reasoning in our ecological works.

For this indispensable dual study of environmental physics and adaptational physiology we have some, though no great, foundation. Our knowledge of the physics of the atmosphere and our methods for investigating it are, thanks to meteorology, fairly satisfactory, but we need a new form of record for meteorological data which will make them more directly available than at present in the interpretation of ecological phenomena. Our knowledge of the physics of the soil, however, involving factors more important in the aggregate than those of the atmosphere, is comparatively scanty, while methods for its exact study are only beginning to be developed. The exact study of soil physics (using this term broadly) seems to me the greatest present single need of ecology. Turning to the other member of the ecological equation, the plant, whose physiological powers and limitations determine its adjustment to particular environments, it appears to be a fact that no attempt has yet been made to apply our considerable physiological knowledge, and our excellent physiological methods, to the elucidation of the physiological life-history of any one of even the important forms constituting our vegetation. Yet it is only through such studies, for which some new appliances and methods must be developed, that we can hope to understand not only the factors involved in the adaptations of the particular form to its environment, but also the nature of the all-important subject of plant-competition, which determines how the forms build up a vegetation. No doubt the subject will ultimately work itself out as a series of ecological life histories, in which the physiological powers and limitations of each plant will be expressed in a system of standard units or formulæ with all the definiteness of the taxonomic terminology of the present day. But such studies as these can not be made by busy teachers who can give to them only a vacation leisure and a scanty equipment. They can be made only by trained investigators who, with ample time, expert assistance, and properly equipped field laboratories, can give themselves wholly to it. Into this fruitful field we welcome the Carnegie Desert Laboratory; may its kind increase until we have not only mountain, jungle, seaside and forest laboratories, but also another form which can be moved from place to place in pursuit of the most pressing problems.

Such seems to me the status of plant ecology at present and the direction it must

take for the future. I propose to discuss now very briefly the principles which appear to me to be fundamental to a right understanding of the nature of ecology.

*Principle 1. The Reality of Adaptation.*—To a first view it seems logically possible that adaptation may have only a subjective existence, and that the cases we consider adaptations may be merely accidental correspondences between certain features of the organism and certain characteristics of the environment, involving no real advantage to the organism. Now there can be no doubt that many cases commonly reckoned as adaptations are of this imaginary nature (it could hardly be otherwise while *post hoc propter hoc* is the prevailing type of ecological reasoning), but that some of our adaptations have an objective existence is susceptible of direct proof. Thus the mechanisms connected with cross-pollination in specialized orchids represent a typical adaptation. If, without other injury to the plant, these mechanisms are prevented from operating, no seed is formed and the result is disastrous to that race of plants. Hence the advantage of the mechanism is made manifest, and the reality of the adaptation is proved.

This case illustrates the fundamental idea, and permits a definition, of adaptation. It is an adjustment between some feature of an organism and some characteristic of its environment such that the organism functions better than it could did such an adjustment not exist.

*Principle 2. The Evolutionary Phylogeny of Adaptation.*—Logically two views are possible as to the phylogeny of a real adaptation. (1) It may have developed quite independently of any connection with the environment it now fits and have come into its present relation with that environment by a sort of sifting process permitted by the constant movement or circulation of organisms in nature, very much as a number of vari-shaped blocks shaken in a box having vari-shaped cells opening from it would each come finally to fill the cell with which it most nearly corresponds in shape. (2) It may have arisen gradually, either by innumerable fine gradations or by somewhat marked steps, in close touch with the environment, which may be acting either directly causatively or only selectively. The former view has received its strongest advocacy in the recent book by Morgan, while the latter is that almost universally prevailing, and, as I believe, correctly. There is no doubt that some adaptation is of the former sort; and in some phases of ecology, notably in distributional phenomena of ecological plant geography, it plays an important rôle. But that adaptation is usually and essentially of this character seems to me wholly denied by the evidence. There is not, so far as I know, any form of proof that can be adduced to decide between these two possibilities, but there is an argument from probability so strong as to be practically conclusive. It lies in the cooperation of many distinct features of adaptation to fit a form to a very special or unusual environment requiring simultaneous and different kinds of modification in many parts. Thus, to take the case of epiphytes (such as the tropical epiphytic ferns), if these were adapted in but one feature alone, such as the roots, it would be logically quite possible that this kind of root had arisen by some method independent of contact with the environment, and that this form having been brought accidentally into this habitat persists there because these roots fit that environment better than any other. But the probability that this adaptation of the roots has arisen independently of the environment is greatly weakened when we note that so different a structure as the leaves are also, and equally well but in a different way, adapted to this habitat. And when, further, we observe

that adaptations equally good but of a different kind are found in the stems, in the tissue systems, in several phases of irritability and in other features all involving considerable changes from the ancestral forms, then the chances that all of these adaptations, involving most or all of the external structures of the plant, could have arisen without regard to the environment become so small as practically to disappear. On the other hand, the development of adaptations in causative touch with the environment, by whatsoever method the modification may be brought about, gives a perfect explanation of such cases of concomitant adaptations as are here in consideration.*

Adaptation, as the probabilities overwhelmingly indicate, usually develops in touch with the environment. But from the point of view of the ecologist the method of evolution, whether by selection of fluctuating variations, by inheritance of individually acquired characters, by mutations or by some other method yet unknown, is a matter of only incidental and not of essential interest. On the other hand, it is altogether likely that adaptation, properly studied, will throw light upon the method of evolution, for it is probably true that adaptation has been in some measure the guide of evolution; or, to express the subject in another way, adaptation seems to bear to evolution a relation somewhat analogous to the relation of a stimulus to its irritable response.

*Principle 3. Adaptation a Race, not an Individual, Process.*—Many phenomena in organic nature point to a distinction between the race and the individuals which compose it. The distinction is not metaphysical but physical, though its precise physical basis is uncertain, the race having its basis in the protoplasm, or the part of it, bearing the characters common to all the individuals, and the individual having its basis in its share of the race protoplasm plus the differences which are its own alone. Now as to the relation of adaptation to race *vs.* individual, two views are possible, aside from any theories: (*a*) adaptation originates and develops in the individuals, and then, by a method unknown, becomes fixed in the race (a corollary of which is that the individuals are the leading or important element in organic nature, the race being secondary); and (*b*) adaptation is primarily a race matter, finding its visible expression in the individuals (a corollary of which is that the race is the leading and important element, the individuals being secondary to it). The former is the popular conception and that of some students, but the available evidence seems to point overwhelmingly to the correctness of the second. The phenomena exhibited by the social insects among animals, the regular transmission of both sexes through one sex, and the phenomena of reproduction generally can only be explained on the basis of race adaptation being dominant over individual

* These cooperations of many adaptations fitting a form to a particular habitat, involving changes in many features simultaneously, seem to me to offer one of the very greatest difficulties to the selection theory of the development of adaptations. On the hypothesis of selection of fluctuating variations, favorable variations in one feature bear no relation to favorable variations in another, except in rare cases of correlation. When, therefore, selection is preserving the individuals favorably varying in one character, it is surely preserving unfavorable variations in some other characters. Selection, it would seem, could only produce adaptive modifications in one or a very few characters at a time, and hence simultaneous modifications in many distinct characters, such as actually appear to have occurred in such cases as epiphytes, would not be possible. The mutation theory offers even greater difficulties. The Lamarckian (Neo-Lamarckian) theory, on the other hand, admits of indefinitely numerous concomitant or simultaneous adaptations, though this theory has its difficulties from other points of view.

adaptation. The distinction often made between adaptations for the good of the individual, such as irritable responses to stimuli, and those for the good of the race, such as various reproductive processes, is merely a matter of convenience without logical basis, for not only is the line between the two extremely indefinite, but also it is evidently as necessary for the good of the race to preserve the reproducing individuals as to secure their reproduction. Adaptation may apparently all be reduced to a race basis, only that being individual which is connected with individual variability. The relation of the race to the individual appears to resemble somewhat the relation of the mortality tables to the individual human life; or the race is like a mighty moving current, while the individuals are the ripples that play upon its surface or the eddies that swirl in its depths. In practice, therefore, adaptation is to be studied from the point of view of its advantage to the race under consideration rather than from the point of view of its individuals; and, further, conclusions can not safely be drawn from individual cases, but must be based upon studies of the race, which can be accomplished best through the use of statistical methods. A corollary of this principle is this, that the meaning of adaptation is to be sought deep in the activities of protoplasm rather than in the superficial manifestations of structure. Structure is but the external manifestation of protoplasmic activity, the tool, as it were, by the aid of which the protoplasm more perfectly accomplishes its work.

*Principle 4. Metamorphic Origin of Adaptation.*—In such cases as I can recall, in which the phylogeny of an adaptive feature is known with reasonable certainty, it seems to be the case that the new adaptation has not arisen *de novo* out of the plant substance, but through the metamorphosis of some preexistent feature, itself formerly adaptive. It seems to me logically a probability that adaptations frequently, if not generally, have their origins in the metamorphoses of preexisting adaptations, and *omnis adaptatio e adaptatione* may yet become a postulate of ecology. The origin of a new adaptation, upon this principle, would be somewhat after this manner. When changing environmental conditions, or the opening of a new field, bring about a need for a new adaptation, both change and need arising very gradually, this need can be met, and a new adaptation can arise, only in case there is available in the plant some existent feature which happens to be capable of filling that need in its earliest stages, and of being modified to fill it better, either by selection of its fluctuating variations or mutations, or by more direct method, as the need becomes more intense. In such a case, when the full intensity of the need has been reached, the modification or metamorphosis of the original feature will have gone so far that we recognize a new adaptation. If, however, no feature capable of filling the need in its earlier stages exists, or if the need arises too suddenly, then there is no adaptation, the organism can not meet the new conditions confronting it, and it must either keep to its old mode of life, or, if that be impossible, become extinct. Such a principle gives a logical explanation of the remarkable irregularity of distribution of adaptation at the present day, and removes much of the difficulty as to the origin of new adaptations. In discussing the origin of adaptation we too often forget, not only that the need for new adaptations must arise as a rule very gradually, but also that the modifying agency, whatever that may be, makes its effects felt very gradually; or, as it may be expressed, the plant is passed from under the action of one adapting agency to the action of another not

suddenly but gradually. It certainly seems as logical that both adaptations and adaptive agencies should show continuity as that organisms should; and we should be able to trace adaptations back, precisely as we trace organisms, through simpler and simpler conditions until we reach the ultimate origin of them all in the simple undifferentiated protoplasm of the original organisms.

*Principle 5. Inevitable Imperfection of all Adaptation.*—It appears to be true that no feature of any organism is free to respond unhampered to the influence of an agency producing adaptation. Inevitable impediments to such complete responses arise from several sources—from various hereditary influences, from physical and chemical limitations of their powers, from the necessity of providing for nutrition, support and protection, from the presence of other adaptations, and from the presence also, it is possible, of other features highly developed without reference to any utility. The result of the operation of all of these influences upon any feature is a state of equilibrium, of which adaptation is a part, no doubt usually as large a part as the other conditions will permit, but frequently only a minor part. In every case, therefore, adaptation must fall below its perfect development, or must be imperfect. Of no feature can it be true that it is all adaptation, but it must be adaptation plus other considerations, and the latter in any structure may collectively even outweigh the former. Now it is without doubt the task of the ecologist not only to determine adaptation, but as well to delimit the other influences which interoperate with it to make structures what they are. In other words, it is the task of the ecologist to determine the meaning of the features of the plant whether that meaning involves adaptation or not.

Such seems to me the nature of adaptation as indicated by the evidence we possess. Certainly it is true that ecology is but in its beginning. W. F. Ganong.

Smith College, Northampton, Mass.

## SCIENTIFIC BOOKS.

### PALMER'S 'INDEX GENERUM MAMMALIUM.'*

Dr. Palmer's 'Index Generum Mammalium' is a work of immense labor, painstakingly and intelligently performed, and its publication will form a landmark in the history of mammalian nomenclature. It furnishes not only an elaborately annotated list of all the generic and family names of mammals, recent and extinct, published since the beginning of the binomial system of Linnæus down to the end of the year 1903, but the introduction, besides disclosing the origin, history and scope of the work, furnishes a fund of historic information that should most favorably influence the methods of the future in the bestowal and use of names by systematists, not only in mammalogy but in other departments of natural history.

The work consists of an 'introduction' of about 70 pages, followed by Parts I.–III., with an appendix, and an index to Part III. Part I. comprises 'Index of Genera and Subgenera' (pp. 71–717); Part II., includes the 'Family and Subfamily Names of Mammals' (pp. 719–776); while Part III. is an 'Index of Genera Arranged According to Orders and Families' (pp. 777–948). The appendix contains names discovered too late to insert in their proper places in Part I. and various additions and corrections, by means of which 'the index is brought down to January 1, 1904.'

In the 'introduction' (pp. 8–69) there is first a statement of the history and purpose of the work. From this it appears that the work was begun by Dr. C. Hart Merriam about

* 'Index Generum Mammalium: A List of the Genera and Families of Mammals.' By T. S. Palmer, Assistant, Biological Survey. Prepared under the direction of Dr. C. Hart Merriam, Chief of Division of Biological Survey. North America Fauna No. 23, U. S. Department of Agriculture, Division of Biological Survey. Washington, Government Printing Office, 1904. (January 23, 1904.) 8vo, pp. 984.

1884, and was taken in hand by Dr. Palmer in 1889, who continued it, aided by competent assistants, till its completion in 1903, it being carried on in connection with the systematic work on mammals conducted by the Biological Survey. Under 'acknowledgments' special mention is made of the careful and painstaking work of Miss Thora Steineger, who spent much time in several of the leading libraries of Europe in verifying references, besides rendering important clerical assistance in Washington throughout the progress of the work. Especial thanks, on behalf of the users of the index as well as the author, are also rendered to Mr. F. H. Waterhouse, librarian of the Zoological Society of London, who, on learning of Dr. Palmer's work, generously placed in his hands a large amount of manuscript he had already prepared for a similar undertaking.

The introduction treats in much detail all the principal questions, moot and otherwise, that relate to nomenclatural usage. Under 'References and Dates' is considered the important question of what constitutes publication, and the necessity of determining, and respecting, actual dates of publication, which are often difficult to ascertain. In this connection is presented a useful list of special papers giving dates of publication for works issued in parts, and dates of the parts of the 'Proceedings' of a number of scientific societies and museums. Under 'Authorities and Localities,' and 'Types and their Determination,' are treated important questions of usage about which authorities often differ, as the determination of types of genera, etc., apropos of the author's methods in the present work. A list of 'Hypothetical Genera' is accompanied by pertinent comment; 'Changes in Form of Names' covers a consideration of the much-vexed question of the proper treatment of 'emended' names. On this point the author says: "Probably no section of the A. O. U. Code has been the subject of so much criticism as Canon XL., which provides that 'the original orthography of a name is to be rigidly preserved, unless a typographical error is evident.' Stability and priority are two of the cardinal principles of the code, but priority is merely a means of securing stability, and applies as well to the adoption of the earliest name as to the earliest form of that name. Experience has shown that any other course leaves the door wide open to emendation and resultant confusion." A number of generic names are cited, having from five to eight variants that have been more or less in use, in illustration of the results of emendation; and in further elucidation of the extent to which emendation may be carried, it is shown that the name *Aplodontia*, with eight actual variants, 'is capable of at least twenty-four modifications, each one differing from the rest by a single letter.' Some eminent zoologists maintain that a difference of a single letter in two names is sufficient to distinguish them, and to prevent the later name or names (for there are often several) from being thrown out as preoccupied, whether the difference in form is due to gender, to a difference in the connecting vowel in compound words, or to the presence or absence of aspirates; while others consider names the same when having the same etymological origin, though differing in form.

Under 'Rejection of Names' the author considers at length the following topics: 'Preoccupied names,' under which is given a most useful 'List of Homonyms within the Class Mammalia; and another list of preoccupied names in mammalogy and ornithology; 'nomina nuda,' French common names of Latin derivation, 'plural subgeneric names,' etc.

Pages 41–46 are devoted to the 'Etymology of Names,' under which are considered classical names, barbarous names, 'nonsense names' ('coined' names and anagrams), mythological names, geographical names, personal names, compounds and double generic names. These pages contain an immense amount of information, both historic and etymological, in reference to the sources and relative prevalence of these different classes of names, illustrated by tabular expositions, which are not only of high interest but of much practical utility, but which it is impossible here to particularize. The section devoted to 'Application of Names' (pp. 60–

'67) also abounds in interesting and practical information.

In Part I., 'Index of Genera and Subgenera,' the names stand in alphabetic sequence, and under each are given from half a dozen to a dozen distinct and important items of information, as follows: Author and date; the order and family to which it is referred; the place of its original publication; its variants, if any, and by whom, when and where published; its type if specified, and if no type was given by the author, and none has been since 'fixed,' a list of the species originally included under it; the locality whence, and the place where the type was described, and, if an extinct species, the character of the type specimen, and its geological formation and locality; its etymology and significance, or, in the case of a barbarous name, its original source and use. If the name be antedated or preoccupied, these facts are duly noted; and where the same name has been proposed for different genera of mammals, its several uses are given chronologically. In this way the history and status of each name is fully set forth, so that its availability or non-availability is easily determined. In no other work has such fulness of treatment been given, nor is it easy to see where anything essential to the history of a name has been omitted. As the 'index' includes upward of 4,500 names, the immense amount of labor involved in its preparation is evident, while no similar work is to be compared with it in fulness of detail and consequent usefulness. Of these 4,500 names, it is stated that over 400, or 10 per cent., prove to be preoccupied, and of these latter 'about 150, or nearly 40 per cent., are homonyms in the class Mammalia' (p. 953).

In Part II., 'Family and Subfamily Names,' the treatment is necessarily different, in accordance with the requirements of the case. Here the name, author, date and the order to which it is referred are stated, followed by a reference to the place of first use, with secondary references to its variants, if any, and modified uses as regards the rank of the group. The arrangement is, of course, alphabetic, and the index proper is preceded by several pages giving the history of the origin and use of such names, particularly in reference to the final adoption of the terminations *idæ* and *inæ*, indicating respectively families and subfamilies. There is also a summary of the rules that have been proposed by different nomenclatural codes in relation to these groups, and illustrations of the difficulty of applying these rules.

Part III., 'Index of Genera Arranged According to Orders and Families,' has been prepared to show 'what names have been used in a certain group, why a name is unavailable, or whether any published name is available for one which is preoccupied.' The arrangement is here alphabetic, first as regards orders, and secondly as respects the families, subfamilies and genera, within the orders. The classification adopted is that of Flower and Lydekker in 'Mammals, Living and Extinct' (1891), with modifications; the nomenclature, however, is often different. 'The name of the class Mammalia,' says the author, 'is one of the few names concerning which there is universal agreement.' After illustrating how modern authorities differ in respect to the names of even the primary divisions of the class, the author gives an outline of the classification and nomenclature here adopted, and an explanation of his system of cross references designed to facilitate the finding of any desired name.

This part of the work is especially important, and amounts to, practically, a revision of the nomenclature of the Mammalia, recent and extinct. In respect to family names, the name based on the earliest generic name has been adopted when available, as when the genus on which it is based is not antedated or preoccupied. Under the family name are cited (1) its synonyms and subfamilies, (2) its genera, with the author, date and type species of each. Recent genera are distinguished from extinct genera by the use of black-faced type for the former and italic for the latter; preoccupied names have a dagger (†) prefixed, but names otherwise untenable appear not to be designated, except as shown by the context.

The appendix adds 35 names discovered too late to be included in Part I. These include

a few from Frisch (1775) and a considerable number from Billberg (1828), and others proposed during 1903. These early names are fortunately merely *nomina nuda,* or synonyms, or otherwise untenable. The appendix also includes several pages of corrections, some of them important, affecting the authorities for a few genera given in Part I., and in one case the orthography of a name, *Tayassu* G. Fischer (1814) becoming *Tagassu* Frisch (1775), with a corresponding change in the family name based on this genus.

It can not be supposed that a work of this character can be entirely free of errors, but with the great care taken in the preparation of the manuscript (see p. 11) they are doubtless reduced as nearly to a minimum as can reasonably be expected. The work embodies the results of a vast amount of labor, for which mammalogists can not be too grateful; it has set a high standard for future workers in the same line to emulate; and has placed in the hands of experts in nomenclature an invaluable aid in their work. J. A. A.

*Monograph of the Coccidæ of the British Isles.* By ROBERT NEWSTEAD. Vol. 2. London, Ray Society, 1903. Pp. 270; 41 plates.

The long-expected second volume of Mr. Newstead's monograph is at last to hand, and we have in the completed work the best treatise on the Coccidæ yet published. The beautiful colored plates, the excellent notes on habits and modes of occurrence and other good features maintain the high standard set in the first volume; and as before, many of the species are as familiar in America as they are in England.

The nomenclature employed is in most cases very different from that of Mrs. Fernald's new catalogue, although the more recent views are discussed in an appendix. Mrs. Fernald's catalogue had not appeared when Mr. Newstead's volume went to press, which is to be regretted, as it contains much bibliographical matter which would have been of service to the author. In the present state of coccidology any writer may well be excused for not accepting all the recently proposed innovations; but it does seem to me that some of them stand on unassailable ground, and should not be resisted by any logically minded person. For example, *Pseudococcus* can not be allowed to stand for species, none of which were placed therein by the describer of the genus.

As regards both genera and species, Mr. Newstead is a 'lumper,' though by no means a reckless one. I have been studying his excellent descriptions and figures, and find that, according to the system represented by Mrs. Fernald's catalogue, the following changes (among others) should be made:

*Lecanopsis formicarum,* Newst., becomes *Spermococcus formicarum.*

*Dactylopius pulverarius,* Newst., becomes *Trionymus pulverarius.*

*Ripersia terrestris,* Newst., becomes *Rhizœcus terrestris.*

*Ripersia halophila* (Hardy) becomes *Ripersiella halophila.*

Thus four genera are added to the British fauna; the third, however, evidently introduced by man. The indication of these generic relationships, whatever may be thought of the genera, is strongly suggestive of certain specific resemblances. It is not improbable that future careful comparisons will bring to light some synonymy.

If, as Mr. Newstead holds, all the British forms of *Phenacoccus* (he calls them *Pseudococcus*) are of one species, the conclusion seems almost irresistible that *Phenacoccus pruni* (*Coccus pruni,* Burm., 1849) is its proper name. According to Mr. Newstead's figures, the second antennal joint, while usually considerably longer than the third, varies to about equal with it. Among our American species, these joints also vary, but we have recognized what appear to be three different types, not normally intergrading:

1. Second and third joints nearly equal. *P. dearnessi, rubivorus, minimus, spiniferus, acericola.*

2. Second conspicuously longer than third. *P. solenopsis, helianthi, wilmattæ, artemisiæ, cevalliæ.*

3. Third conspicuously longer than second. *P. osborni, simplex, stachyos.*

These species of course have other peculiarities, but I certainly have believed that the

antennal characters (allowing a good deal of variation) were specific. Of course, it is quite possible that the English insect is more variable than the American ones, as is true of certain English plant genera, *e. g., Rubus* and *Hieracium.*

One of the best tests in all such cases is the transplanting of specimens to different food-plants. Mr. Newstead did this rather extensively in the case of *Pulvinaria ribesiæ,* which he treats as a variety of *P. vitis.* It was found that the *P. ribesiæ* could not live on certain plants which are normally infested by *P. vitis,* and this, I think, should make one hesitate to assume the identity of closely similar forms.

*Dactylopus walkeri,* Newst., is evidently the British representative of our *D. neomexicanus,* the antennæ and other characters being very similar. In the figure accompanying Newstead's original account of *D. walkeri* the last antennal joint was apparently made too short.

It is strange that no mention whatever is made of *Lecanium liriodendri,* which was described from English specimens.

T. D. A. Cockerell.

## SCIENTIFIC JOURNALS AND ARTICLES.

*The Popular Science Monthly* for March opens with an article on 'Aerial Navigation,' by O. Chanute, which gives a résumé of what has been accomplished up to the present. W. LeConte Stevens discusses 'The Metric System: Shall it be Compulsory?' intimating that it must not be. J. Madison Taylor has a second paper on 'The Conservation of Energy in Those of Advancing Years' and Edward F. Williams has the first of a series of articles on 'The Royal Prussian Academy of Science, Berlin.' N. L. Britton describes 'The Tropical Station at Cinchona, Jamaica,' and Edw. D. Jones discusses 'Education and Industry,' noting the changes that have taken place in training for commercial life. O. F. Cook presents a paper on 'Evolution Not the Origin of Species,' holding that while evolution may change the character of species it does not originate them, this being due to vital motion. Lafayette B. Mendel gives 'Some Historical Aspects of Vegetarianism' and Naohidé Yatsu gives a sketch of 'Tokyo Teikoku Diagaku (Imperial University of Japan).'

*The Museums Journal* of Great Britain for February contains an article on 'The Museum Question in Europe and America,' by Ant. Fritsch, in which the author notes that many undesirable features are to be found in museum buildings through the undue influence of architects. It is noted that most exhibition collections are too large and a plea is made to have them of smaller size and greater educational value. Alex. M. Rodger describes 'A Method of Mounting Fish with Natural Surroundings,' large, rectangular tanks being employed and the fish preserved in formalin. A meeting is noticed to consider 'The Organization of British Zoologists' and the balance of the number is filled with reviews and notes.

We learn from the *Journal of the American Medical Association* that Dr. K. Kjellberg, of Stockholm, has commenced the publication of a weekly medical journal, to be the official organ for the General Swedish Medical Association. The title is *Almänna Svenska Läkartidningen.* The first two numbers contain instructive articles on 'Arrhenius and the Doctrine of Immunity' and others on Finsen treatment of lupus, paraffin prothesis, etc. The list of collaborators on the journal includes Professor E. Almqvist, J. Borelius, H. Köster and seventeen others. The journal *Eira* was previously the organ of this association, but it suspended publication on the death of its editor, Dr. Simon, last June.

## SOCIETIES AND ACADEMIES.

### GEOLOGICAL SOCIETY, WASHINGTON.

The one hundred and fiftieth meeting of the society was held January 27.

Mr. Wm. H. Dall read a paper on 'The Miocene of Maryland and its Relations,' in which the relations of the Chesapeake Miocene of Maryland to that of Virginia, North Carolina, Florida and the Miocene of central and northern Europe were elucidated and discussed. This paper will form a chapter in the forthcoming report on the Miocene of Maryland,

in the publications of the Geological Survey of that state.

Mr. Ralph Arnold then presented a paper on the 'Faunal Relations of the Carrizo Creek Beds of California.' He first described the physiographic features of the Carrizo Creek country, which lies in San Diego County on the edge of the Colorado Desert near the Mexican boundary line. The faunal relations of the mollusks of the formation were next discussed. The molluscan fauna indicates that the Carrizo Creek beds are for the most part of Miocene age, that they were laid down in comparatively shallow water, and that their fauna bears little relation to other known California Miocene, but is intimately related to the recent fauna of the Gulf of California. These facts point to the conclusion that during at least a part of the Miocene period the Carrizo Creek country was occupied by a tropical shallow sea or gulf, an extension of what is now the Gulf of California; and that this gulf was separated from the cold waters of the main California Miocene sea by a peninsula similar in position to the present peninsula of Lower California. In other words, he concluded that the major physiographic features in the peninsular and gulf region of Lower California were approximately the same in Miocene times as they are at present.

This was followed by a paper by Mr. T. Wayland Vaughan, entitled 'A Californian Tertiary Coral Reef and its Bearing on American Recent Coral Faunas.' The coral reef, concerning which he spoke, occurs in San Diego, County, California, the locality being the same as that of the Carrizo Creek beds described in the preceding paper by Dr. Arnold. Mr. Vaughan first called attention to the striking difference between the recent coral faunas on the Atlantic and Pacific sides of subtropical America.

In the collection that has so far been made from the California fossil reef five genera are represented, all of which occur in the fossil and recent faunas of the Antilles and not one of which is at present known to occur on the Pacific coast. The age of the beds in which these fossils occur has been determined by Drs. Arnold and Dall to be Lower Miocene. The following conclusions seem warranted: (1) There was water communication between the Atlantic and Pacific across Central America not much previous to the Upper Oligocene or Lower Miocene, that is, during the Upper Eocene or Lower Oligocene. This conclusion is the same as that reached by Messrs. Hill and Dall, theirs, however, being based upon a study of the fossil mollusks. (2) During Lower Miocene time the West Indian type of coral fauna extended westward into the Pacific and it was subsequent to that time that the Pacific and Atlantic faunas have become so markedly differentiated.

ALFRED H. BROOKS,
*Secretary.*

NEW YORK ACADEMY OF SCIENCES.
SECTION OF BIOLOGY.

AT the February meeting the following papers were presented:

*A New Gigantic Tortoise from the Miocene of Colorado:* O. P. HAY.

This tortoise was discovered during the year 1901 by Mr. Barnum Brown, of the American Museum of Natural History, in the Pawnee beds of the Miocene, in the northeastern part of Colorado. The remains consist of the shell complete; the skull, lacking the lower jaw; the pelvis and hind limbs; the terminal portion of the tail; and portions of the dermal armor. These materials were exhibited before the academy.

The length of the carapace is about 31 inches. It is high and tumid, with the sides at the bridge perpendicular, and with the hinder border little flaring. The outline is truncated in front, broadly rounded behind, and only slightly repand. The free edges are acute. The bridge peripherals rise somewhat above the middle of the height of the shell, their length transversely to the animal being nearly equal to that of the costal plates. The nuchal scute is narrow; the vertebral scutes not so wide as the costal scutes. The anterior lip of the plastron is broad, rounded in front, and slightly notched in the midline. The posterior lobe has a broad, shallow notch. The pectoral scutes are extremely narrow.

The skull has the palate deeply excavated. The masticatory surface on each side is traversed by a prominent, sharp and dentated ridge. The oral surface of the premaxillaries is excavated for the reception of the tip of the lower jaw. The cutting border of the maxilla is coarsely dentated.

The exposed portions of the hinder limbs, and probably of the fore limbs also, were protected by an armor of dermal bones, as in some living species of the genus. The extremity of the tail is expanded and covered on the upper surface by a plate composed of several bones joined by sutures. The skin of the region around the tail was provided with many pebble-like dermal bones. On the hinder part of each thigh there was a large bony spur. All these bones were covered in life with a thick layer of horn. This new species is named *Testudo osborniana,* in recognition of the interest of Professor H. F. Osborn in the fossil testudines.

Remarks were made by the author of the paper on the geographical and geological distribution of the genus *Testudo* and its related genera, and on their probable origin.

*The Flora of Dominica:* F. E. Lloyd.

This paper gave a general account of the vegetation of the Island of Dominica, which the author visited during last summer.

The island is of volcanic origin, remarkably broken in contour, and very difficult for travel. The rainfall is excessive, but with considerable differences in distribution. For example, on the west coast there is a mean annual rainfall of 59.51 inches, while 239.50 inches were reported for Middleham in 1901, an amount not far from the mean. The eastern slopes of the island are exposed to the trade winds, and the vegetation, from the shore line to the top of the mountains, shows the effects in the peculiar molding. The temperatures are not excessive, but the atmospheric humidity is great.

The vegetation, excepting in certain restricted areas, is of the tropical rain-forest type. The large trees are clothed with a heavy epiphytic growth chiefly composed of bromeliads, aroids, orchids, ferns and a *Cyclanthera.* At the higher levels the Hymenophyllaceæ, Musci and Hepaticæ predominate, among which, however, many larger ferns and small orchids find a place. Four species of tree ferns, and several species of palms are to be found. *Heliconia,* a plantain-like plant, is very abundant at high altitudes. Lianas and 'ropes,' as air roots are called locally, are abundant.

In the Grand Savannah desert conditions prevail, caused by the small rainfall (59 inches) and the shallow soil underlaid by trap rock. The vegetation here, and along the rocky shore, is quite distinct in character. A viviparous agave and four cacti are here to be found. The savannah is a sloping grassy plain with scattered shrubs and small trees among which occur several Mimosoideæ.

The strand vegetation on account of the steep, gravelly character of the shore is meager in species. The sea-grape (*Coccolobis uvifera*) is everywhere, and *Ipomœa pes-capræ* and *Canavalia* are common. *Terminalia* occurs in some localities.

M. A. Bigelow,
*Secretary.*

THE ACADEMY OF SCIENCE OF ST. LOUIS.

The academy now meets in its own building, at 3817 Olive St., and held its regular meeting on February 15.

Rev. Martin S. Brennan delivered a popular lecture on the 'Nebular Hypothesis' according to La Place, illustrated with lantern slides. In the discussion following, Mr. Nipher remarked that he had applied the equations for gaseous nebulæ, which had been deduced in his paper on the 'Law of Contraction of Gaseous Nebulæ,' to the case of our own planetary system.

Introducing an integration constant into the pressure formula, the pressure and, as a consequence, the temperature, can be made zero at any radius from the center. He had given the constant a value which made the mass of the nebula equal to that of the entire solar system. When the nebula has reached such a stage that the mass external to Neptune's present orbit is equal to Neptune's mass, the density at Neptune's orbit will be $1.93 \times 10^{-15}$ grams per c.c., and the pressure will be $1.49 \times 10^{-10}$ atmospheres. The

outer limit of the nebula will be about half a million miles further out, the temperature being zero at the outer limit. This means that molecular motion will not there exist. The forces there acting will be gravitation and the repelling action of light waves from the central nucleus.

The entire mass of Neptune will exist in a space far more highly rarefied than any Crookes tube vacuum.

It is, of course, possible for such nebulæ to exist, but it certainly is impossible to believe that such a nebula can throw off a system of planetary bodies. The greater part of our solar nebula must have existed as solid meteoric matter, with a temperature approaching absolute zero. Only the central part, which is now represented by the sun, was largely gaseous, and at a higher temperature.

## DISCUSSION AND CORRESPONDENCE.

### INSTABILITY OF THE WATER SUPPLY OF THE RIO GRANDE.

To the Editor of Science: In 1540 when Coronado's men were exploring on the Rio Grande, they reported arriving eighty leagues below Tiguex at a place where the river vanished into the ground. Some Amerinds of the region told them it reappeared again much larger farther down. This they did not verify.

As their report of this disappearance, I believe, has usually been ascribed to 'Spanish exaggeration,' it is interesting, as well as important, to place beside it Humboldt's mention, in his 'Political Essay on New Spain,' p. 213 (English translation by John Black), of a similar phenomenon, which took place in 1752.

> The whole bed of the river became dry all of a sudden for more than 30 leagues above and 20 leagues below the Passo, and the water of the river precipitated itself into a newly formed chasm and only made its reappearance near the Presidio de San Eleezario. This loss of the Rio del Norte remained for a considerable time; the fine plains which surrounded the Passo and which are intersected with small canals of irrigation, remained without water and the inhabitants dug wells in the sand with which the bed of the river was filled. At length after the lapse of several weeks the water resumed its ancient course, no doubt because the chasm and the subterraneous conductors had filled up.

From this it seems fair to infer that the Spaniards of 1540 were witnesses of a phenomenon which repeated itself in 1752.

Springs have also been known to be changed, in that region, by earthquake shocks, and it would, therefore, appear that in the past there has been considerable instability in the water supply. There is a probability that a large branch entered the Rio Grande, from the northeast, just above El-Paso, in Coronado's time, which has since vanished, leaving only marshy spots where it once ran. These changes in volume of springs and in streamflow have, it is needless to say, an important bearing on the archeology of that district.

F. S. Dellenbaugh.

## SPECIAL ARTICLES.

### BIOLOGICAL SURVEY OF THE WATERS OF SOUTHERN CALIFORNIA BY THE MARINE LABORATORY OF THE UNIVERSITY OF CALIFORNIA AT SAN DIEGO.

The marine biological survey undertaken by the Department of Zoology of the University of California of the Pacific Ocean adjacent to the southern coasts of the state in 1901,* continued for six weeks in the summer of 1902 at San Pedro, with a limited amount of shore work and some attention to the plankton of San Pedro harbor, and transferred in the summer of 1903† to San Digeo or, more specifically, to Coronado on the peninsular side of the Bay of San Diego was again taken up during the holiday intermission of the university for a period of three weeks from December 15, 1903, to January 6, 1904. The committee of the Chamber of Commerce of San Diego, which raised the funds for the work of the preceding summer provided also, in the

* W. E. Ritter, 'A Summer's Dredging on the Coast of Southern California,' Science, Vol. XV., p. 53, 1902.

† W. E. Ritter, 'Preliminary Report on the Marine Biological Survey Work carried on by the Zoological Department of the University of California at San Diego,' Science, Vol. XVIII., pp. 360–366, 1903.

main, for the explorations of the winter. The laboratory was again opened in the boat-house, partially equipped and courteously placed at the disposal of the Chamber of Commerce by the Coronado Beach Company. The laboratory was fortunate in again securing the services of Mr. Manuel Cabral as collector, and the power boat *St. Joseph,* by means of which it was possible to have collections made in the early morning ten to fifteen miles off shore from Coronado brought to the laboratory early in the forenoon for the day's work.

The climatic conditions were ideal for winter work. Bright sunshine every day and an equable temperature obviated the necessity of artificial heat in the laboratory, and no storms interfered with the regular trips of the collector. Tides at this season of the year are also favorable, reaching lowest levels in the afternoon, while in the summer the best tides for shore collecting all occur before daybreak or early in the morning. The persons engaged in the survey and subjects of their investigations were as follows: Professor W. E. Ritter, director of the laboratory, *Balanoglossus, Tornaria,* pelagic and littoral tunicates; Assistant Professor Charles Kofoid, pelagic Protozoa; Dr. Alice Robertson, Bryozoa and Copepoda; Mr. L. H. Miller, assistant in zoology, and Mr. R. D. Williams, a graduate student, working with Professor Kofoid on the Protozoa and Miss Margaret Henderson continuing her work of last summer with Dr. H. B. Torrey, on the pelagic Cœlenterata.

The physical observations made in the previous summer by Mr. H. M. Evans on temperatures and salinity were continued this winter by Professor W. T. Skilling, of the San Diego Normal School. These observations show, as might be expected, that the shallow bay waters have cooled down more than the surface waters of the adjacent ocean. Whereas last summer the bay waters were 4°–5° C. warmer than the ocean, they were in midwinter 1°–2° cooler. Temperature in summer in the bay ranged from 22.7° to 26.7°, in winter from 13.3° to 14.7° C. Surface waters in the adjacent ocean in summer ranged from 18° to 22.5° except during a cold spell August 27–31, when they fell as low as 14.8°. In winter the range was from 14.6° to 15.6°.

The salinity also declined slightly below the summer determinations, the average of the readings, reduced to Dittmar's standard, of ocean water (at Coronado pier falling from 1.02455 to 1.023748; of the middle portion of the bay near the mouth of Glorietta Bight at Coronado falling from 1.02546 to 1.024274. Determinations of salinity were also made in the mid-channel between Coronado and San Diego at the ferry crossing, yielding an average of 1.023927.

The biological explorations of the winter were again directed in the main to the plankton. Quantitative examinations were made of the plankton of the Bay of San Diego near the laboratory and of Glorietta Bight. Surface waters of the ocean off-shore from Coronado were also examined, but the principal field of operations was 'Cabral's bank,' an uncharted area about ten miles off Point Loma with 60–90 fathoms of water, known to local fishermen. A number of hauls were also made in the adjacent deeper waters of the Coronado submerged valley.* In all of these localities there was a noticeable decrease in the quantity of the plankton as compared with that taken in similar hauls of our nets in midsummer. There was a marked diminution in the quantity of diatoms and a still more pronounced reduction in the volume and variety of the Peridinida. *Gonyaulax,* which was so abundant in August as to color the water and cause an appreciable odor along shore, was found in living condition but a few times though empty skeletons were still not infrequent. The Tintirnidæ, on the other hand, were abundant in the ocean waters and showed marked increase over summer ratios in the bay. The Radiolaria were also, relatively to summer conditions, greatly increased in numbers and variety in all collections made some distance off shore, but were not common

* George Davidson. 'The Submerged Valleys of the Coast of California, U. S. A., and of Lower California, Mexico.' Proc. Calif. Acad. Sci. Geol., Third Ser., Vol. I, pp. 73–103, Pls. 2–10, 1897.

in bay and coastal waters. The Acantharia, which in summer abound in shore and bay waters, were less abundant everywhere this winter. The Spumellaria were also somewhat reduced in frequency, while the Nassellaria were greatly increased and diversified in waters near the 100 fathom line, where the major part of our oceanic collections were made, rivaling if not surpassing in richness the *Challenger* collections from the tropical Pacific as reported by Haeckel.

The Cœlenterata are reported by Dr. H. B. Torrey to be fewer in the winter collections, both as species and as individuals, in all orders but the Siphonophora, where numbers were much larger, especially of *Diphyes*.

The Entomostraca were less abundant than in summer, especially in shore waters. *Sapphirina* was found several times and an apparently new 'peacock form' allied to *Calocalanus* was obtained. *Cyphonautes* was very common in all collections, and Ophio-, Echino- and Asteroplutei were not infrequent, indicating breeding of many echinoderms at this season of the year.

The pelagic Mollusca were more numerous than in summer. *Creseis* and young *Pneumodermon* were found, and young *Pleuropus* were very abundant in the oceanic collections.

Professor Ritter reports the presence of *Salpa, Doliolum* and *Appendicularia* though less abundant than in the summer. A small *Tornaria* of uncertain relationships was found this winter in small numbers on the bank where the large *T. ritteri* was found last summer.

A few collecting trips were made at low tides and some dredging was done off shore and in the harbor. *Ciona* was exceedingly abundant and of great size in loose colonies on the sand in the shoal waters of the harbor, and *Perophora* and sponges were in great breeding activity on the floats and piles near the laboratory. *Amphioxus californicus* was again collected on the 'middle ground' near the mouth of the harbor in shelly deposits, and *Dolichoglossus* was found in great abundance on the mud flats about the bay associated with another possibly new member of the genus. *Cerianthus* and *Renilla* were collected on the sand and the mud flats exposed at low tide. Many annelids were breeding in the mud flats about the harbor and in the False Bay. New collecting grounds on the ocean front near Pacific Beach were found on rocks exposed at low tide, which equal in richness and in variety of their fauna anything thus far found on the coast of California south of Monterey Bay.

One of the most noticeable changes in the local fauna was an unusual development of a large bryozoan, *Bowerbankia*, in the harbor, forming masses often several feet in diameter. This species was dying out rapidly during our stay at Coronado, living zooids being very rare on the colonies. Another remarkable change was the development of *Donax californicus* in great numbers at Pacific Beach, where on a gently sloping sandy shore in the notoriously heavy breakers of the region these little lamellibranchs were found in enormous numbers, literally covering the beach on a strip several miles in length and fifty yards or more in width. The levels at which they occurred would bring them into the turmoil of the breakers with every tidal recession during plus tides and leave them exposed on the beach for several hours during minus tides. A similar occurrence at Long Beach near Los Angeles several years ago led to the formation of a fertilizer corporation to exploit these resources of the sea, but *Donax* disappeared before the stock was floated, as mysteriously as it came. Associated with *Donax* in what seems to be a commensal relationship is an undescribed Campanularian hydroid attached to the shell in small tufts between the umbo and siphons. This was sufficiently abundant to add an appreciable color to the banks of *Donax in situ* on the beach.

*Chimæra* was caught on the fishing banks and *Gyropleurodes* was taken in the Bay.

A great abundance of animal life is thus available at San Diego in winter months for the biologist, and the desirability of this location for the establishment of a marine station open throughout the year grows increasingly evident.

In furtherance of this object a Marine Biological Association was formed at a public

meeting of interested citizens of San Diego and vicinity September 27, 1903.

The by-laws as adopted designate the purposes of the organization and in part are as follows:

"The organization shall be called the Marine Biological Association of San Diego, for the purpose of securing the foundation and endowment of a scientific institution to be known as the 'San Diego Marine Biological Institution.'

"The general purposes of the institution shall be to carry on a biological and hydrographic survey of the waters of the Pacific ocean adjacent to the coast of South California, to build and maintain a public aquarium and museum and to prosecute such other kindred undertakings as the board of trustees may from time to time deem it wise to enter upon.

"The founding of the institution having been perfected and its endowment secured, the whole or such part thereof as may in the judgment of the trustees seem best shall, under such conditions as the trustees may impose, be transferred to the regents of the University of California, to become a department of the university coordinate with its already existing departments.

"The officers of the association shall be a president, vice-president, scientific director, secretary and treasurer. In addition there shall be a board of trustees consisting of seven members, three of whom shall be the president, vice-president and scientific director."

Officers were elected as follows:

*President*—Homer H. Peters.
*Vice-President*—Miss Ellen Scripps.
*Scientific Director*—Professor W. E. Ritter.
*Secretary*—Dr. Fred Baker.
*Treasurer*—Julius Wangenheim.
*Additional Directors*—E. W. Scripps and James MacMullen.

At a winter meeting of the board of trustees funds were guaranteed for three years which will enable the station to continue its work and expand it somewhat, perhaps to the extent of keeping the station in partial operation throughout the year in charge of a resident naturalist or fellow during the interim between the summer and winter operations. A public spirited patron of the laboratory has offered to grant the laboratory the use of a nineteen ton schooner, the *Loma*, former pilot boat of the port, equipped with power, for purposes of collecting, sounding, dredging, etc., and also to erect a temporary building for accommodation of the laboratory which may be located at La Jolla, fifteen miles from San Diego on the ocean front. The permanent location of the buildings will not be determined until a thorough exploration of several possible situations shall have been made.

Charles Atwood Kofoid.

### THE NECESSITY FOR REFORM IN THE NOMENCLATURE OF THE FUNGI.*

The nomenclature question is almost entirely one of expediency. If the prevailing custom in making plant names has led to the establishment of a nomenclature that satisfactorily fills the requirements for accuracy and stability, and if it points out unfailingly the proper procedure where our increased knowledge of any given group of plants necessitates the modification of our ideas of generic limits, then any change in traditional methods, or any attempt to substitute other generic names for those now commonly used, would be a folly so great as to approach lunacy. Let us see what the facts are as regards the fungi. Fries, in his classical work 'Systema Mycologicum,' the final volume of which was published in 1829, recognized 243 genera of fungi. In the 'Sylloge Fungorum' of Saccardo, the eight original volumes completed in 1889 contain 1,685 genera and 31,927 species. Supplementary volumes have appeared from time to time, the last in 1902, bringing the total number of recognized genera up to 2,348 and the species to almost 50,000. The treatment of the fungi by Schroeter, Lindau, Hennings Dietel and Fischer in Engler & Prantl's 'Pflanzenfamilien' was completed in 1900. The usage here differs radically from that of Saccardo in many respects and the number of genera accepted is only 1,811, or 537 less than are recognized by Saccardo. A

* Read before the Botanical Section of the American Association at the St. Louis meeting.

comparison of the generic treatment in the two works has not been attempted for all the groups. The following, however, will show that this difference in numbers is not a mere multiplication of genera by Saccardo. Of the 54 genera of the Agaricaceæ given by Hennings in Engler and Prantl, 15, or nearly 28 per cent., are not recognized by Saccardo, many of them not appearing even as synonyms, though his work is two years the later. If we reverse the comparison, the showing for uniformity in modern usage is much worse, since of the 82 genera given by Saccardo only 41, or exactly 50 per cent., are recognized in Engler and Prantl. This is certainly a case where it will be difficult to say what is the 'prevailing usage.' Taking the Hymenomycetes as a whole, Engler and Prantl give 147 genera, 25 of which, or 17 per cent., are not recognized by Saccardo. If these glaring differences cause us to investigate as to which of these works is based on the more logical and consistent usage, and, therefore, which is the safer nomenclatorial guide, we are forced to the conclusion that neither of them follows any recognizable or consistent rule of nomenclature. The case of each genus seems to have been settled on an independent basis and according to the whim of the moment. Doubtless the claim would be made for each work that the names were selected on the basis of priority, but priority has been flagrantly and repeatedly violated in both of them.

Again is the 'prevailing usage' furnishing us at the present time with a safe rule for the establishment of new genera on a sure and stable basis? That this is no idle question is shown by the vast increase of over 2,000 genera since 1829 and of 663 since 1889, if we count on the basis of the 'Sylloge,' and the tendency is for the still more rapid multiplication of genera in the near future. Every revision of a large genus in these days results in breaking it up into smaller generic groups. It is vitally important that this shall be done on some basis that will prove stable. What is really being done is illustrated by a recent revision of *Ravenelia*. After an exhaustive and critical study of the species the author very properly decides to break up the genus. He leaves the majority of the species under the old generic name and proposes new names for the smaller segregations. Now it happens that *Ravenelia* was founded on a single species, *R. glandulosa*. In the proposed revision this species falls in one of the smaller groups and is no longer called a *Ravenelia*, while that name is applied to a group of species none of which were included under it by the author of the genus. If priority is to be more than an empty name such practices can certainly not be allowed to stand unchallenged, yet the author could point to hundreds and hundreds of precedents to justify his usage. In fact, we must admit that this usage has been the prevailing one ever since the time of Linnæus. The chaotic condition that must inevitably be produced by following this so-called 'method of residues' is well illustrated by the following figures taken from my work as a member of the nomenclatorial committee in finding the types of the older genera of fungi. I have listed 485 names that were proposed between 1753, the first edition of Linnæus's 'Species Plantarum,' and 1821, including the first volume of Fries's 'Systema Mycologicum.' Of these, 242, or one half, are to be rejected for various reasons. Some are hyponyms, never having been associated with a recognizable binomial species; some are typonyms, being based on species already used as the types of other genera; some were only proposed as subgenera, and some were based on sterile mycelia, monstrosities, insect work or plants that are not fungi. The remaining 243 names are available for use at the present time. The types of these have been determined according to the code proposed at the Washington meeting. One hundred of them, or 41 per cent., were monotypic, being based on a single species. In 135 of them, or 55 per cent., the type was determined by page priority. Nine are historic types taken from pre-Linnæan authors and 4 were inferred from the form of the specific name. Of these 243 available names, 118 are used by Saccardo in their proper historic sense, being still associated with their original type species. In the other 125 cases the names are either not

given by Saccardo or they have been shifted from their proper historic use and do not now contain their original types. Of course, in some cases this is correct, since the list includes some metonyms where the type falls within the limits of an earlier valid genus. The number of these has not been determined, since it will depend on the conception of generic limits and will necessarily change from time to time with the increase of our knowledge. As genera are now recognized it probably does not exceed 20 per cent. This would leave an estimated 218 valid genera to 100 of which, or 45 per cent., the oldest available name is not applied by Saccardo. Of the 100 monotypes 58 appear in Saccardo under their original name, while 42 must be sought under other genera. In one case noted, five genera have at different times been founded on the same type species, and three of these names are still doing duty in both Saccardo and Engler and Prantl.

Glaring inconsistencies like those might be cited almost endlessly. The above, however, is sufficient to show conclusively first, that we have at present no widely accepted 'prevailing usage' in regard to the names of fungus genera; and secondly, that the usage that has prevailed in the formation of generic names has not led to stability or to the establishment of any logical system of procedure. In fact, the existing condition is so confused and anomalous as to imperatively demand an immediate and sweeping reform. Doubtless all will now agree that any rational system of nomenclature must be based strictly on priority. This in itself is a long step in advance, for only a generation ago the foremost systematists laid less stress on priority than on the supposed appropriateness of a name. The unfortunate result of their practices has just been passed in review. While all will agree on the basic principle of priority there will be divergence of opinion when the attempt is made to formulate a code of rules for applying it. The ideas and methods of the earlier writers were so diverse from our own that it is impossible to bring their work into harmony with ours without adopting rules and methods that are necessarily more or less arbitrary. It is perfectly clear that they had no idea of the type of a genus or a species in the sense in which we use the word to-day. Their 'type,' in so far as they had one, was a mental concept; and yet if we are to prevent this endless shifting of generic names from one group of plants to another, it becomes necessary to tie down these ancient concepts to the material basis of a single species. The exact way in which this is to be done really matters very little. No rule or system of rules can possibly be devised which, if consistently followed, will not throw out or change the meaning of many of the names accepted by modern writers. Any attempt at reform based on a method devised for the purpose of 'saving names' can only end by adding to the existing confusion. Let us then nerve our minds to the point of seeing not only any, but, if necessary, all of our most favored names sacrificed to consistency, and unite in adopting the simplest and most direct code of rules that can be agreed upon. When this is once done and its provisions are carried out in good faith we shall by the one cataclysmic effort have placed the nomenclature of our science on so firm and stable a basis that we need no longer dread the appearance of each succeeding contribution to mycological knowledge on account of the changes in names that have been so constant and so annoying an accompaniment of each forward step in the past.

F. S. Earle.

New York Botanical Garden.

### ENERGETICS AND MECHANICS.

Within the past ten years energetics has been brought to the front as furnishing a systematic account of phenomena that are connected most directly with quantitative relations of energy, and of its transformations. To any one who has stood aloof from the polemic between the 'energetic' and the 'forcive' view, it must seem proved that the former has rendered a permanent service to physics, by devising and putting into circulation forms of statement that are freed from superfluous hypothetical assumptions, and brought closer to the foundations of natural science in ascertained facts. For example, the

current of thought, simplifying and clarifying in this sense, that runs through Professor Ostwald's 'Naturphilosophie' is undeniable, whatever particular attitude between full acceptance and opposition we may take toward the author's expressed or implied philosophy. But in summing up the gain due to such movements, that lesson from history must not be lost sight of which teaches that a new interpretation of phenomena rarely supersedes the previous views; it most often supplements and modifies them. So here, while we may accept the suggestion from energetics, and cry good riddance to a cumbrous apparatus of molecular forces, premature, at least, for our present state of experimental knowledge and, perhaps, finally illusory, it is not required by consistency to follow the extremists in their tendency to banish the conception of force completely, nor need we even derive those parts of mechanical doctrine which are stated through equations of motion from an exclusive source in energy relations.

It is something, of course, that we have a direct and roughly quantitative appreciation of force through muscular sensation; but further, attacking the matter more broadly, several points may be urged in restraint of relegating force to the scientific lumber-room. First, let us grant fully one great advantage of an energy equation: that it renders possible a true statement of relation between conditions at the boundaries of an interval, while we are ignorant of the internal mechanism, *i. e.* the details within the interval. But let us notice, also, that this is coupled with a corresponding disadvantage. The energy equation is not immediately capable of recording internal details, even where the process has been traced continuously or minutely; and to this extent it fails to represent completely our acquaintance with those cases. In parallel with the energy equation (the integrated form), therefore, the force equation or its equivalent (the differential form) is then justified and requisite. That is, though it is well to acknowledge ignorance and bridge the gap with the energy equation, yet it would be pedantic to use equations of that type exclusively, and thus ignore knowledge that we really possess. Secondly, it is part of the general intellectual position which has led to the development of energetics, that the introduction and use of physical quantities are to be determined according to their convenience and sufficiency. Now it is true and interesting that the condition of equilibrium (zero value of accelerations) can be described as a compensation of one form of energy by another (Ostwald, passim); but that does not settle any question of practical convenience in the definite calculation of conditions for equilibrium. And it is precisely when those conditions obtain, that one factor of energy becomes indeterminate or unimportant, leaving attention to be concentrated upon the remaining factor. Hence the universal procedure in measuring the forces, pressures, etc., that are practically essential elements in a state of balance, through the whole range from constructing the piers of a bridge to applying D'Alembert's principle. For the purpose of physics it is not always enough to know that an algebraic sum is zero; the magnitude of the self-neutralizing terms is of importance. To be sure, this particular aspect of the situation may be met by using freely coordinate derivatives of energy, and thus narrowing the question to the choice between the directer and the more artificial introduction of the necessary forces. But even this resource would not occupy the vacant field entirely; a third point remains to be considered. What account does the view peculiar to energetics give of normal forces, those actions which guide moving bodies without directly affecting their energy of motion? The scalar kinetic energy is unaffected by mere change of direction; there is no measurable exchange of energy (apart from friction) between a body moving with constant speed in a curved path and the guiding mechanism. Yet these are not instances of equilibrium, either, describable in terms of compensating forms of energy; none of the extensions of energy equations to cover tangential forces by means of coordinate derivatives apply here. This seems to be the weakest spot in the scheme of energetics, at which it stands most in need of supplement by direct use of equations of motion. Everywhere

in dynamics the directive forces play a prominent part. Nor is this necessarily confined to molar mechanics; wherever the generalized equations of Lagrange are proved to be serviceable, the significance of the term $\partial E/\partial s$ cannot be overlooked. It registers the occurrence of directive or guiding forces, as a type, in conjunction with those whose form $(d/dt \cdot \partial E/\partial v)$ indicates their relation to changes of energy. FREDERICK SLATE.

UNIVERSITY OF CALIFORNIA,
February 24, 1904.

## QUOTATIONS.

### PRESIDENT ELIOT.

'NATURE's patient ways shame hasty little man,' a sentence from one of President Eliot's lectures, is the keynote to much of his work; for he has made nature's patient ways his own. He celebrates to-morrow (March 20) his seventieth birthday, and this year, also, the thirty-fifth anniversary of his presidency of Harvard. For an estimate of his achievements this is neither the place nor the time: the limits of an editorial article are too narrow; and his labors are, we trust, far from an end. *Serus in cœlum redeat.* But we add our hearty congratulations to those of Harvard graduates, friends of learning from all colleges and schools, and worthy citizens in every walk of life; and we seize this moment as suitable for dwelling on two or three aspects of President Eliot's career. He stands among the foremost citizens of the United States; were there a common denominator by which one could measure men of widely different talents and callings, he might rank the very first. This success is indubitably due in large part to a power which has wrought, like the force of a glacier, without haste, and without rest.

It is as an educator that he enjoys the widest fame. For more than a third of a century—a period of unexampled material progress—in a country which has leaped forward rather than developed, he has been at the head of our oldest and richest university. He has thus enjoyed a unique opportunity to set his stamp upon the educational system of a nation; and this opportunity he has employed to the uttermost. The principles which he intended to follow he laid down with precision in his Inaugural Address in 1869; from those principles he has never swerved. He declared: "This university recognizes no real antagonism between literature and science, and consents to no such narrow alternatives as mathematics or classics, science or metaphysics. We would have them all, and at their best." Against the old hard and fast curriculum—"one primer, one catechism, one rod for all children"—he set his face unflinchingly, and proceeded to build up the elective system, which at Harvard already rested on a firm foundation. The opposition within his faculty and without was determined, sometimes bitter. His theory that "a well-instructed youth of eighteen can select for himself—not for any other boy, or for the fictitious universal boy, but for himself alone—a better course of study than any college faculty, or any wise man who does not know him and his ancestors and his previous life, can possibly select for him"—this theory was assailed and ridiculed as individualism run mad. But President Eliot held to his course, and he has seen his theory accepted in every important college of the country. He has weathered the storm that raged about him twenty years ago, and has anchored in the desired haven.

As champion of a movement which put sciences and modern languages in 'fair competition' with the classics, he has urged unceasingly more skillful instruction in these new subjects. In his Inaugural, he bluntly told the 'scientific scoffers at gerund grinding' that 'the prevailing methods of teaching science the world over, are less intelligent than the methods of teaching language.' Experimentation in the laboratory, original investigation, drill in accurate observations, he has made the burden of many addresses and reports. Moreover, it is owing largely to his efforts that the standard of professional schools has been raised, and that secondary and grammar schools are now reorganizing their programs according to the modern idea of developing the aptitudes of the individual. But it is upon English that he has laid the greatest stress. He began his presidency by

quoting Locke's complaint as to the neglect of the mother-tongue; and he has returned to the theme again and again. At Harvard he has built up an English department that has been a stimulus to every other college and to schools of all grades.

In this vast enterprise, President Eliot himself, the moving spirit, has had neither the authority nor the will to force the action of faculties or committees. More than once he has seen his opinions thrown into the arena of open debate and voted down. But, convinced that his views, if sound, will ultimately triumph, he has waited with Olympian calm for the march of events. Though the immediate effect of the changes has in some cases seemed to be chaos, he has never been discouraged; he has shown that, to rearrange a curriculum, to train competent instructors in new subjects, to establish traditions of mental discipline, will be the task of generations yet to come.

In his discussion of public questions he has insisted upon the right of the individual to attain his highest intellectual and moral development, unchecked by a cast-iron regimen of studies, or by intolerance in church or state. His criticisms of organized labor have voiced the conviction of our sanest publicists, that 'democracy must profoundly distrust the labor union's too frequent effort to restrict the efficiency and the output of the individual workman.' This doctrine of individualism, a tenet of the liberals of the old school, is falling into temporary decay; it is opposed by certain captains of industry, who want to crush out the individual and pile merger upon merger; it is opposed by the trades unionists, who condemn all laborers to the lock-step; yet President Eliot has steadily, with candor and courage, striven for the basic principle of our Declaration of Independence.

These are the achievements, these the qualities that have won him, year by year, a wider recognition; have transmuted cold respect into affection. In the earlier days of his presidency a reserve of manner, absorption in details of administration, and a frank indifference to the gusts of undergraduate sentiment made students regard him with an uncomfortable awe, as if he were a sort of Iron Chancellor in an empire of education, or—to recur to a former comparison—as if he were really a glacier. Time has proved the falsity of this first impression; has shown that no college president has endured with more serenity and good humor the criticism of his colleagues; that the springs of his kindness are as unfailing as the waters that melt from the eternal ice. He has reached the goal of his ambition. In describing Dr. Asa Gray's life as 'happy,' he declared: "It is the greatest of human rewards to be enfolded, as years advance, in an atmosphere of honor, gratitude and love." That greatest of rewards President Eliot himself has reaped in full measure, while his eye is not dim nor his natural force abated.—*New York Evening Post.*

## *NOTES ON INORGANIC CHEMISTRY.*

### WATER GAS IN THE CHEMICAL LABORATORY.

A PAPER was recently read before the Society of Chemical Industry by Masume Chikashige and Hitoshi Matsumoto on the defects of uncarburetted water gas as a fuel for laboratory use. Inasmuch as water gas is more or less extensively used in cities and as small local water-gas plants are easily installed, extended studies of its use have been made by the authors, resulting in its condemnation. Among the reasons given for these conclusions are the following, which seem most important.

While the water-gas flame is non-luminous and always powerfully reducing, it is often desired to have a smoky flame temporarily, which is impossible with this gas, nor is it possible to produce a flame to any considerable extent oxidizing in its nature. The air openings in a Bunsen burner are useless, as it is not possible to mix more than a very slight proportion of air with the gas without producing an explosive mixture. The intense heat of the flame, far higher than can be obtained with coal gas, is not an unqualified advantage, as it occasions the rapid destruction of wire gauze and copper vessels; copper air baths and water-baths are rapidly destroyed, unless provided with cast-iron bottoms. Owing to the presence of carbon monoxid, nickel vessels are quickly corroded, some crucibles being burnt completely through in a single

operation. Platinum vessels are seriously damaged, becoming brittle, and at the same time increasing in weight, owing to the deposition of iron from the iron carbonyl formed in the passage of the gas through iron pipes. A similar deposit, which can not be wiped off, is formed on the bottom of porcelain crucibles, precluding the use of such crucibles in quantitative analysis. It was found that a very considerable quantity of unconsumed carbon monoxid escaped into the air, so that this could easily be injurious to health. In a laboratory where thirty coal-gas burners may be kept going without detriment to health, hardly eleven water-gas burners can be used with impunity. In the ensuing discussion of the paper it was suggested that where the water gas is carburetted, as is usual in this country, it is probable that it is less objectionable as a laboratory fuel.

### YELLOW ARSENIC.

The yellow modification of arsenic, which has been observed by several chemists, has been submitted to a careful examination by Erdmann and Unruh, and their results are published in the *Zeitschrift für anorganische Chemie*. The yellow arsenic corresponds to white phosphorus, and is produced by rapidly cooling the vapor of arsenic. In practice the best method was found to be sublimation in a tube of aluminum in an atmosphere of inert gas. The fumes are cooled rapidly by absorption in carbon bisulfid, in which yellow arsenic is soluble. When a saturated solution is cooled to —70° it deposits the yellow arsenic in the form of a yellow powder, which can be preserved at this temperature without change if kept in the dark. When exposed to light, even in solution, it is rapidly changed to ordinary arsenic. After a time a brownish-red precipitate is formed in the carbon bisulfid solution which seems to be a fourth modification, and reminds one of red phosphorus. The molecular weight of the yellow arsenic was determined, and the molecule corresponds to $As_4$.

### COPPER CYANID SOLUTIONS.

In the same journal is a paper by F. P. Treadwell and C. v. Girsewald on the colorless solution of copper cyanid, which is not precipitable by hydrogen sulfid, and which is very familiar to all students of qualitative analysis. The compound present in this solution is variously given in different text-books, some considering it merely a double cyanid of bivalent copper and potassium, as $K_2Cu(CN)_4$, while others affirm that the copper is present in univalent form, being reduced by the potassium cyanid. For this the formula $KCu(CN)_2$ is sometimes given. In both cases it appears wholly a matter of mere conjecture. The authors studied solutions containing various proportions of copper and potassium cyanid, and arrived at the conclusion that the salt present is $K_4Cu_2(CN)_6$, though the salt itself was not isolated. The complexity of the ion which is not decomposed by hydrogen sulfid was determined to be $[Cu_2(CN)_6]^{iv}$, by the use of cryoscopic methods.

### CORROSION OF IRON WATER MAINS.

An interesting case of corrosion is reported from Frankfurt in the *Zeitschrift für angewandte Chemie*, by Martin Freund. This pipe contained in places holes as large as the palm of the hand. On the edges of these holes the iron had been converted into a dense, dark gray, soft mass resembling graphite. Analysis showed the mass to be composed of ferrous phosphate, ferrous silicate, carbon, and ten per cent. of metallic iron. As the surrounding soil could not have supplied the phosphorus or silicon, it appeared that all the materials had come from the iron itself. By the action of stray electric currents the phosphorus and the silicon of the iron had been oxidized to phosphate and silicate. In order to test this supposition, Freund subjected a portion of the cast iron of the pipe as anode to the action of an electric current in a dilute salt or gypsum solution, and found that in a short time the iron became coated with a deposit containing phosphate and silicate of iron, and in every respect resembling the corrosion product of the pipe.

J. L. H.

## *A QUARTERLY ISSUE OF THE 'SMITHSONIAN MISCELLANEOUS COLLECTIONS.'*

The Smithsonian Institution has commenced the publication of a Quarterly Issue

of its 'Miscellaneous Collections,' 'designed chiefly to afford a medium for the early publication of the results of researches conducted by the Smithsonian Institution and its bureaus, and especially for the publication of reports of a preliminary nature.' The first number of the Quarterly Issue is a double one and contains seventeen articles, ranging in size from 1 page to 73 pages, in addition to notes on the activities of the institution, its collections, etc., the whole accompanied with fifty-six plates and numerous text figures. The scope of the journal is broad, the first issue embodying articles on mammalogy, astrophysics, paleontology, archeology, geology, ornithology, ichthyology, ethnology, etc., thus covering a considerable range of scientific subjects. The number in hand opens with a description of 'Seventy New Malayan Mammals,' by Gerrit S. Miller, Jr., based on collections made and presented to the National Museum by Dr. W. L. Abbott. Mr. C. G. Abbott presents the results of 'Recent Studies of the Solar Constant of Radiation,' conducted at the astrophysical observatory of the institution, under the direction of Secretary Langley. Another paper by Mr. Abbott describes 'The New Cœlostat and Horizontal Telescope of the Astrophysical Observatory,' in which are given the results obtained with a device designed by Secretary Langley for the purpose of 'churning' a column of air traversed by a solar beam, with the view of reducing the 'boiling' or confusion of all parts of the solar image due to variability of the strata of air traversed. Dr. F. W. True presents some photographic illustrations of 'Living Finback Whales from Newfoundland,' these being the first photographs of living whales in American waters that have thus far been published. Brief descriptions of 'A Skeleton of Hesperornis,' and 'A New Plesiosaur,' by Mr. Frederic A. Lucas, are given with plates, and Mr. W. H. Holmes illustrates and compares the designs on some remarkable 'Shell Ornaments from Kentucky and Mexico.' A noteworthy specimen of a 'Glacial Pothole in the National Museum' is described by Mr. George P. Merrill, who explains the method by which the specimen was procured. 'Some Notes on the Herons of the District of Columbia,' by Mr. Paul Bartsch, who made a systematic survey of two heron colonies and conducted experiments with a view of solving some of the problems of bird life, is of special interest. Dr. J. Walter Fewkes gives a 'Preliminary Report on an Archeological Trip to the West Indies,' in 1903, describing particularly the remarkable objects of stone, bone, shell, wood and pottery which he collected during the trip, and giving an insight into their various uses. Dr. C. M. Child, of Chicago University, describes the 'Form-regulation in Cœlentera and Turbellaria,' of which he made a special study during his occupancy of the Smithsonian seat at the Naples Zoological Station, and Dr. Carl H. Eigenmann introduces some 'New Genera of South American Fresh-water Fishes, and New Names for Some Old Genera.' Of timely interest is the account of 'Korean Headdresses in the National Museum,' by the late Foster H. Jenings, in which are described and illustrated twenty-four varieties of Korean hats and other headgear, including headband buttons and hatpins for topknots. A brief history of the 'Hodgkins Fund of the Smithsonian Institution,' and of what has been accomplished with its income toward 'the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air in connection with the welfare of man,' bears the name of Helen Waldo Burnside, and is accompanied with an illustration of the beautiful Hodgkins medal. Mr. A. B. Baker gives an account of 'A Notable Success in the Breeding of Black Bears,' which is of special interest to those having charge of animal collections. Of quite a different theme is Dr. James M. Flint's 'Chinese Medicine,' which briefly explains the origin of medicine and the theory of disease in the Celestial Empire. The last of the series of articles consists of 'Notes on the Rocks of Nugsuaks Peninsula and its Environs, Greenland,' by W. C. Phalen, the remaining pages of the journal being occupied by brief descriptions of various activities of the institution and their results.

## BOTANICAL WORK IN THE PHILIPPINES.

Since the American occupation a considerable amount of botanical work has been accomplished on the Philippine flora, under the auspices of the insular government, and in the near future, due to the fact that the appointment of an assistant botanist and two collectors was authorized by the civil commission some time ago, the work will be greatly increased.

Shortly after the organization of the Forestry Bureau in May, 1900, some botanical work was undertaken by Regino Garcia, who had been an assistant in the Spanish Forestry Bureau. Little work, however, of lasting value was accomplished in this office. In April, 1902, the Bureau of Agriculture was organized, and Elmer D. Merrill was appointed botanist. In July, 1902, he was also made botanist to the Forestry Bureau, while in July, 1903, he was transferred to the Bureau of Government Laboratories, when an assistant and two collectors were authorized. The object in transferring the work to the Government Laboratories was to get all work of a similar nature into one institution, and organize a thoroughly equipped botanical laboratory. In November, 1903, Dr. E. B. Copeland was appointed assistant botanist, and Mr. A. D. E. Elmer one of the collectors, the second collector not having as yet been appointed.

In the past two years under Mr. Merrill's direction a herbarium, exceeding 8,000 sheets, has been formed and for a large part identified, a well-equipped botanical library has been established and the following publications have been issued: 'Botanical Work in the Philippines,' 'Report on Investigations made in Java in the Year 1902,' 'A Dictionary of the Plant Names of the Philippines,' 'New or Noteworthy Philippine Plants,' 'The American Element in the Philippine Flora.' The first article was published as a bulletin from the Bureau of Agriculture, the second as a bulletin from the Forestry Bureau, and the last three as bulletins from the Bureau of Government Laboratories.

At the present time, in addition to the work on the Philippine flora being prosecuted under the auspices of the Philippine government, Mr. R. S. Williams is collecting in Luzon for the New York Botanical Garden and Dr. H. Hallier is collecting in Mindanao for the Hamburg Museum. A considerable amount of botanical material was secured by various employees of the Philippine Exposition Board, this material, with the exception of one set retained in the herbarium of the Bureau of Government Laboratories in Manila, having all been forwarded to St. Louis.

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## SCIENTIFIC NOTES AND NEWS.

M. Henri Becquerel, professor of physics at the Paris Ecole Polytechnique, has been elected a correspondent of the Berlin Academy of Sciences.

The University of Chicago has celebrated this week its fiftieth convocation. It has given its LL.D. to five German professors, including Professor Paul Ehrlich, director of the Royal Prussian Institute of Experimental Therapeutics at Frankfort-on-the-Main.

The Senate of the University of Glasgow has resolved to confer its Doctorate of Laws on Mr. G. F. Deacon, civil engineer, of London; on Mr. J. H. Muirhead, professor of mental and moral philosophy in the University of Birmingham; on Dr. W. Stirling, Brackenbury professor of physiology and histology at Owens College, University of Manchester, and on Sir William Taylor, M.D., director-general of the army medical service.

The Turin Academy of Science has awarded one half of the Vallauri prize of $6,000 to Professor Giovanni Battista Grassi, of Rome, in recognition of the value of his researches on malaria.

Dr. George B. Parkin, representing the trustees of the will of the late Cecil Rhodes, sailed for New York on March 16 to assist in the holding of examinations in the United States and Canada for the Rhodes scholarships at Oxford.

Dr. R. O. E. Davis, instructor in chemistry in the University of North Carolina, having been granted a year's leave of absence, sails on April 16 for work in the laboratories of Professors Ostwald and van't Hoff.

THE daily papers state that on the French Line steamship *La Savoie,* which arrived from Havre on March 19, was a commission of men of science to study geology and for general scientific research. Professor Googg of the High School of Commerce at Geneva; Lieut. Bourée of the French navy, Commander Massari of the Italian navy, M. Richard, M. de la Burahaye, Count d'Audiffret-Pasquier, and M. Langlois comprise the commission. The officers were granted leave of absence to come to this country.

PROFESSOR H. F. OSBORN has accepted an invitation to give an evening lecture before the British Association at Cambridge, on August 20, and has chosen as his subject 'The Evolution of the Horse.' He will also lecture before the International Zoological Congress at Berne, Switzerland.

PROFESSOR WILDER D. BANCROFT, of Cornell University, lectured before the students of science in the University of North Carolina on the evening of February 11 on 'Physical Chemistry and General Science.' On the morning of the twelfth he gave a lecture to special students in chemistry on 'Physical Chemistry and the Rare Earths.'

PROFESSOR CHARLES S. HASTINGS, of the Sheffield Scientific School, Yale University, lectured at the Woman's College of Baltimore, on March 14. The title of the lecture was 'A Lost Medieval Art,' Professor Hastings treating the subject of stained glass from a scientific standpoint. A reception by the physics department was given after the lecture.

UNDER the auspices of the Henry Phipps Institute for the Prevention of Tuberculosis, at Philadelphia, arrangements have been made with Dr. C. Maragliano, professor in the University of Genoa, and senator in the Italian parliament, to lecture on March 28, on 'The Serum Treatment for Tuberculosis.'

WE learn from *Nature* that a committee has been formed with the object of obtaining subscriptions for a memorial to the late Professor Nicol, in association with the University of Aberdeen, in which he taught for twenty-five years. The form the memorial should take has not been decided, but a suggestion has been made that if a memorial brass, similar to those erected to the memory of his predecessors, the late Professor Macgillivray and Nicholson, were provided, and placed with them in the University of Aberdeen, the ornithologist, stratigraphist and paleontologist who have brought honor to the university would be fittingly remembered in association with the scene and center of their life work. The secretary and treasurer, to whom subscriptions should be sent, is Dr. W. Mackie, 13 North Street, Elgin.

ARTHUR GREELEY, professor of biology at Washington University, St. Louis, died on March 15 after an operation for appendicitis.

MR. JOHN I. JEGI, B.S. (Chicago, 1896), professor of psychology and physiology in the Milwaukee State Normal School, died at his home in Milwaukee on January 7. Among his publications are 'A Syllabus of Human Physiology' (1901), 'Practical Lessons in Human Physiology' (Macmillan, 1903), and 'A Comparative Study of Auditory and Visual Memory,' in the 'Contributions to Philosophy' of the University of Chicago.

WE regret to record the death of M. F. A. Fouqué, of Paris, the well-known French geologist and mineralogist, on March 7, in his seventy-sixth year.

THE House of Lords has unanimously passed a bill making compulsory the metric system in Great Britain on April 5, 1906, or at such later date as may be directed by an order in council.

THE Washington *Star* states that the Fortifications Board of the War Department, which has appropriated $50,000 for the aerodrome experiments of Secretary S. P. Langley, has decided not to make further appropriations for this purpose.

THE Russian government has offered a prize of about $25,000 for the discovery of some method to make alcohol undrinkable.

THE fifteenth annual session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences will be held at Cold Spring

Harbor during the coming summer. Regular class work will begin on Wednesday, July 6, and continue for six weeks. Investigators may make arrangements for using the laboratory from the middle of June until the middle of September, or later, if desirous of doing so, but board at the laboratory will not be guaranteed after August 20. Application for admission to the laboratory should be made as early as possible, as the earlier applicants have the choice of rooms in the dormitories, and the number of students receiving instruction is limited to 50. The courses of instruction offered are as follows:

High-school Zoology by Professors C. B. Davenport, S. R. Williams and W. M. Wheeler.

Comparative Anatomy by Professor H. S. Pratt and Dr. D. B. Casteel.

Invertebrate Embryology by Professor H. E. Crampton and W. J. Moenkhaus.

Animal Bionomics and Evolution by Professor Davenport.

Cryptogamic Botany by Professor D. S. Johnson and Mr. A. H. Chivers.

Plant Ecology by Mr. Forrest Shreve, of Johns Hopkins University.

Microscopic Methods by Mrs. Davenport.

Courses in beginning investigations are offered, and advanced investigators are offered free use of rooms at the laboratory. The laboratory fee is $30 and room and board are furnished for $6 upward per week. Announcements and further information may be obtained from any of the instructors, or from Professor C. B. Davenport, University of Chicago.

The annual meeting of the Michigan Ornithological Club will be held at the museum of the University of Michigan, at Ann Arbor, on April 2, 1904, in connection with the meetings of the Michigan Academy of Science.

The thirty-eighth meeting of the Eastern Association of Physics Teachers was held in the Newton High School building on Saturday, March 19. Professor S. W. Stratton, director of the Bureau of Standards, Washington, D. C., read papers on 'The Metric System' and on 'The Equipment of Physical Laboratory Workshops.'

A conference of teachers of mathematics, well-attended and representing a large number of universities, colleges and high schools, was held on February 22, 1904, in Columbus, Ohio. This conference decided to form an association of Ohio teachers of mathematics and appointed committees to arrange for a meeting to complete the organization. This meeting will be held in Columbus at the Ohio State University on April 2, 1904. The conference extended an invitation to the teachers of physics and chemistry in Ohio to meet in Columbus with the teachers of mathematics to form a similar organization, with the suggestion that these several bodies be related in some desirable way under the name of 'The Association of Ohio Teachers of Mathematics and Science.'

The fifteenth International Medical Congress will meet at Lisbon April 19–26, 1906.

We learn from *The Geographical Journal* that a project has lately been set on foot for the bringing together into one building of all the scientific societies which have their headquarters in Edinburgh, and a meeting of the fellows of the Royal Society of Edinburgh in support of the proposed scheme was held in the society's rooms on November 26 last, the subject being introduced by a speech by Sir John Murray. The Royal Society occupies a portion of the building known as the Royal Institution, which it shares at present with other public bodies, including the Board of Fishery, the School of Art and the Society of Antiquaries of Scotland, the whole being under the general control of the Board of Manufactures. It has long been thought that the building should be exclusively devoted to scientific purposes, thus, on the one hand, securing a community of interests on the part of all its users, and, on the other, facilitating the work of scientific research by the centralization thus afforded and the avoidance of the dissipation of energy which is to a certain extent the result of the present separation of the societies. It is held that, were the whole building given up to their use, it would be possible to find space for the housing of all the several libraries, including those of the Scottish Geographical and Meteorological Societies, besides allotting to each the rooms required for other purposes, and leaving the

large central hall available for scientific demonstrations, lectures and the like. The proposal found warm support at the meeting alluded to, and a resolution in furtherance of the above-mentioned aims was unanimously adopted.

THE *British Medical Journal* states that a health resort is to be established in Lapland. It is proposed to erect a sanatorium on the shores of Lake Torne, a long and beautiful sheet of water at Wassijauve, near the end of the Ofote Railroad. That railroad, it may be mentioned, has only one station in a distance of 121 miles. There is no human dwelling near that station, which is on the line between Sweden and Norway, and was erected solely for the requirements of the Customs Office. Except for a small settlement at Wassijauve, the only sign of human existence in the district is the occasional passage of a few Laplanders with their herds of reindeer. Apart from the scenery, the inmates of the Arctic sanatorium will have no external object of interest but a scientific station which has been erected with the help of private subscriptions by men of science. The work pursued at the station includes biological, geological, botanical and entomological, and other investigations conducted during the summer, and meteorological, magnetic and other observations made at all seasons. The station is a solidly built block-house containing seven rooms, and it is proposed to build the sanatorium in the same way.

THE *Scottish Geographical Magazine* reports that the 'Société Belge d'Astronomie,' has announced a scheme for the publication of a monograph on volcanoes. This will consist of an atlas containing a general map on the scale of 1:40,000,000, and ten regional maps on the scale of 1:2,000,000, illustrating the general distribution of volcanoes, together with a notice, detailed descriptive tables and block-maps in the text. It is estimated that the text and tables together will occupy about 300 pages, large 8vo. The undertaking will be under the charge of M. Elisée Reclus. In order that the success of this undertaking may be assured, subscriptions are asked for in advance. A subscription of 25 francs will entitle the subscriber to one ordinary copy of the atlas, and one of 100 francs to two copies printed on special paper and numbered. Communications should be addressed to the Society at 21 Rue des Chevaliers, Brussels.

## UNIVERSITY AND EDUCATIONAL NEWS.

SIR DONALD CURRIE has given £100,000 to University College and London University. It is intended with this sum to build a school of advanced medicine.

MR. ANDREW CARNEGIE has given $50,000 to Kenyon College to endow a professorship of economics to be named for Edwin M. Stanton, three years a student of Kenyon, who once said: "If I am anything or have done anything in the way of usefulness, I owe it to Kenyon College." The gift is said to be due to an interview with the late Senator Hanna when sick, who himself had given $50,000 to Kenyon College for a dormitory just now finished.

MR. CARNEGIE has also made a conditional gift of $50,000 to Mt. Holyoke College, the understanding being that the friends of the institution should raise a like amount before June 1. No stipulations are made regarding the use of the money, but it is said that a new library is contemplated.

PLANS have been accepted for the science building given to Rochester University by Mr. George Eastman, of Rochester, at a cost of $60,000, the construction of which will be begun during the summer.

THE new medical laboratories of the University of Pennsylvania will be dedicated on June 11. The laboratories cost $700,000. The principal addresses will be delivered by Dr. H. P. Bowditch, professor of physiology at the Harvard Medical School; Dr. R. H. Chittenden, director of the Sheffield Scientific School, Yale University; Dr. George Dock, professor of medicine at the University of Michigan, and Dr. Horatio C. Wood, professor of materia medica and pharmacy at the University of Pennsylvania.

IT is reported that a plan has been suggested to unite the Columbian and American Universities of the District of Columbia and the

interests favoring a national university, to form the nucleus of a great national university at the capital. The trustees of the American University, with its endowment of $2,000,000 and its tract of ground in the northwestern suburbs, have discussed the project. Bishop McCabe, the head of the university, has spoken favorably of the idea. President Needham, of the Columbian University, and a number of the other officers of that institution have expressed a willingness to meet the officers of the American University to consider the project. It is probable that within the next few months a meeting of the different interests will be had. It is suggested by friends of the plan that such a merger would retain at least one of the strong features of each of the chief institutions and would give much greater financial strength. The plan, however, is chiefly for the establishment of university post-graduate work.

At the meeting of the Association of American Universities held in New Haven on February 18–20, the University of Virginia was elected to membership in that association.

The administrative council of the French Association for the Advancement of Science has offered to defray the cost of a course on physical astronomy at the University of Paris, which will be given by M. Pierre Puiseux, astronomer of the observatory at Paris.

Mr. Edward M. Shepard has been elected chairman of the board of trustees of the College of the City of New York, in place of Mr. Edward Lauterbach, who resigned to accept the position of regent of the University of the State of New York.

Associate Professor Charles B. Davenport, of the department of zoology of the University of Chicago, has resigned to accept the appointment, to which we have already called attention, from the Carnegie Institution as head of the department of experimental biology, which, for the present, is to include a marine station on the Tortugas and a Laboratory for Experimental Evolution at Cold Spring Harbor, Long Island. Professor Davenport is to be in immediate charge of the latter. The buildings in connection with the laboratory are now in process of erection under the direction of Dr. Davenport, who is absent on a vacation during the winter quarter. He will spend the spring quarter at the university and will then leave to take permanent charge of the new laboratory.

Professor L. V. Pirsson, of the chair of physical geology, has been chosen to fill temporarily the curatorship of the geological collection of the Peabody Museum, Yale University, made vacant by the death of Professor C. E. Beecher.

Professor L. H. Bailey, of Cornell University, will superintend the nature study courses in the summer session at the University of Tennessee.

E. V. Huntington, Ph.D., and J. H. Woods, Ph.D., have been appointed instructors at Harvard University in mathematics and philosophy respectively.

The Smith's prizes at Cambridge University have been adjudged as follows: E. Cunningham, B.A., St. John's College, for his essay 'On the Normal Series satisfying Linear Differential Equations'; J. C. M. Garnett, B.A., Trinity College, for his essay 'On the Cause of Color in Metal Glasses and Metallic Films'; H. A. Webb, B.A., Trinity College, for his essay 'On the Expansion of an Arbitrary Function in a Series of Functions'; P. W. Wood, B.A., Emmanuel College, for his essay 'On Covariant Types.'

At University College, London, Dr. G. Dawes Hicks has been appointed to the chair of moral philosophy; Dr. E. R. Edwards, lecturer in phonetics for a term of three years; Dr. H. Batty Shaw, lecturer in therapeutics, and Mr. Percy Fleming, professor of ophthalmic medicine and surgery, in succession to Professor Tweedy, resigned.

Mr. J. J. E. Durack, B.A. (Sydney), B.A. (Research, Cambridge), has been appointed demonstrator in natural philosophy at King's College, London.

M. Fernbach has been placed temporarily in charge of a course in biological chemistry at the Sorbonne, Paris, in place of M. Duclaux, who has been given leave of absence on account of his health.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 1, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *MEETING OF SECTION E OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND OF THE GEOLOGICAL SOCIETY OF AMERICA.*

### PAPERS READ BEFORE SECTION E.

*An American Geographers Union:* WM. M. DAVIS.

There is to-day no geographical society in the United States of organization and rank similar to those of the Geological Society of America. It is believed that the advance of geographical science would be promoted by the organization of a professional society in which only those who have published papers based on original observation should be eligible to membership. A method of beginning the organization of such a society is suggested.

*The Concentration of Geographical Publications:* ISRAEL C. RUSSELL. (Read by title.)

The immediate welfare and future development of geographical science demand that there shall be a union or concentration of the several journals, proceedings, magazines, etc., now issued by geographical societies in North America, and one well-written, well-edited, well-illustrated and well-printed monthly magazine issued. Some of the advantages of such centralization are:

The convenience of reading or consulting one publication instead of many.

Less expense, as may be judged, of issuing one publication in place of several.

The much less expense to subscribers of one publication instead of ten or more as at present.

The larger audience to be secured by one centralized bureau of publication than by any one

and, as there seems no doubt, all of its component bureaus.

Greater promptness in the publication of results in a monthly magazine than in quarterly, annual or occasional journals, etc., as is now the case in several instances.

A larger and more important audience to be addressed on geographical themes, and hence greater inducement for careful preparation and greater care in writing.

Greater dignity and greater influence of one strong publication than of many, several of which are weak.

The employment of one instead of several editors, thus saving both time and money.

Greater revenues to be expected from advertisements from one widely circulated magazine than in the case of several local journals, etc., as at present, but few of which derive any assistance from this source.

The greater inducements which one widely circulated magazine would have in securing contributions from distinguished investigators, well-known explorers, etc., over a less widely distributed publication.

The probability that the proposed magazine, on account of its increased earning power over that of the several local publications now issued, would be able to pay for leading articles.

Important also is the fact that the concentration of geographical literature in one series of volumes, instead of several independent series as at present, would be conducive to the saving of time and energy on the part of all future generations of geographers who may wish to consult the writings of their predecessors. In order to gain these many and great advantages, geographical societies are asked to relinquish some of their purely local interests and look for compensation for such losses in the wider diffusion of geographical information and a more general awakening to an interest in geographical work.

*Fossiliferous Sandstone Dikes in the Eocene of Tennessee and Kentucky:* L. C. Glenn.

Fossiliferous sandstone dikes are found to occur in basal Eocene clays in Tennessee and Kentucky. The dikes have no definite orientation. They vary in width from mere stringers to masses several feet in width. The fossils are casts and are of Eocene aspect. The sands filling the fissures are micaceous and are regarded as derived from certain Eocene sands interbedded with the clays. There is no definite evidence as to their mode of origin, but as the region has recently suffered repeated earthquake shocks, it seems probable that it has similarly suffered in the past and that the fissures are of earthquake origin.

*The Fauna of the Potter Creek Cave:* W. J. Sinclair. Presented by J. C. Merriam. (Illustrated with lantern slides.)

The Potter Creek cave contains fossil remains representing a Quaternary fauna which has heretofore been very imperfectly known. Recent explorations in this and adjacent caves have brought to light over fifty species of mammals and birds. Of this number many forms are new. The paper treats of the occurrence of the remains and the general relationship of the fauna.

*Evidence of Recent Differential Movement along the New England Coast:* Geo. Carroll Curtis. (Read by title.)

Evidence of change of level of the land in respect to the sea in recent geologic time has been noted by Shaler, De Geer, Stone and Willis. Davis has described a coastal plain of recent origin in the vicinity of Portland. Tarr and Woodworth lately report shore lines on Cape Anne up to eighty feet. A range of earlier shore margins from a few feet above tide in Boston Bay to 1,300 feet or more on Mount Desert has thus been recorded. Detail study within this zone, however, indicates that these movements have not been continuous. On Monhegan Island, ten miles off the middle coast of Maine, there are strongly marked shore lines 160 feet above present sea level, with an amount of wave work in the hard

gabbro rock 40 feet above the present limits of waves, approximating that done at the sea margin of to-day. Glacial drift has apparently been largely removed through wave action. On the lower Matinicus Group, which lies some twenty miles to the eastward, banks of what seems to be glacial drift are now being rapidly cut away by the sea. Had these two groups of islands taken part in the same movements permitting the strong bench cutting in the hard rocks of Monhegan, the preservation of the yielding till has yet to be explained. A suggestion from this evidence is that the recent movements have not been continuous throughout the region.

*The Two Classes of Topographic Relief:* George Carroll Curtis. (Read by title.)

During the last few years there has been both in this country and in Europe discussion in regard to the 'proper method' for representing the surface of the earth in relief. Some of this discussion has been, it appears, over two distinct kinds of work under a single classification. These two classes, though not yet generally designated by separate terms, are labeled here as Classes I. and II.

CLASS I.

Requisites of Class I.

A miniature or replica of the earth's surface.

A characteristic reproduction of the topographic form.

As to scale; true.

Detail of form; in same proportion as general scale.

Color; consistent with natural laws.

Culture; indicated by the forms which characterize it.

CLASS II.

Attributes of Class II.

An expression of a map in relief.

An arbitrary representation of the topographic form.

As to scale; optional.

Detail of form; according to choice.

Color; any desired scheme or pattern.

Culture; indicated by any method or arbitrary sign which may seem desirable.

While these requirements and attributes cover but a portion of the subject, they may serve to illustrate the principles underlying it. Should Class I. be designated as topographic models and Class II. as relief maps (or by any more appropriate names) Class I. would include poor 'models' and Class II. good 'relief maps.' A poor 'model' would be one which, while attempting to follow the principles governing its class, does so in an unskillful and inexpressive manner. The requirements of a good 'relief map' are more difficult to state since, being of empirical character, based upon standards of choice, the style of relief maps may be subject to changes of fashion. It seems reasonable, however, to assume that the most satisfactory work in Class II. will eventually be based on a thorough understanding of the principles governing Class I.

PAPERS READ BEFORE THE GEOLOGICAL SOCIETY OF AMERICA.

*Observations on the Geography and Geology of Western Mexico:* Oliver C. Farrington. (Illustrated by lantern slides.)

This paper describes a journey from Durango westward to Ventanas across the plateau of the western Sierra Madre. The plateau exhibits a comparatively unbroken surface rising gradually from a height of 6,000 feet at Durango to about 9,000 feet farther west. It then slopes toward the Pacific and is deeply dissected by streams. Evidence is adduced to show a rather rapid eastward movement of the divide. The region is for the most part comparatively arid, although on the western edge of the plateau extensive forests occur. The rocks are largely eruptive. The Carro Mercado or 'Iron Mountain' is described in some detail and its origin discussed, as is also an area

of remarkable forms, produced by erosion, known as the 'City of Rocks.'

*New Studies in the Ammonoosac District of New Hampshire:* C. H. Hitchcock.

For several years the author has been investigating the geology of the only part of New Hampshire which yields fossils, hoping to be able to interpret the mutual relations of the several formations as revealed by paleontology and a better understanding of the petrography. The fossils have been renamed by Mr. Schuchert. (1) The rock masses in this district formerly referred to; porphyritic gneiss, lake gneiss, Bethlehem gneiss, protogene, diorite and hornblendites are now regarded as igneous instead of metamorphic stratified terranes. (2) The fossils belong to the middle upper Silurian. (3) The rocks of Blueberry Mountain exhibit the synclinal structure—consisting in the upward order of limestones, argillite, conglomerate and black argillites. Only the limestones contain fossils. (4) Different ranges of argillite having somewhat diverse petrographical character are now esteemed to be equivalent—the variations being supposed to have been occasioned by a greater or less metamorphic action. (5) Careful scrutiny of the slates reveals both a cleavage different from the stratification, and a structure analogous to stratification produced by a multitude of minute fractures. (6) The areal distribution and stratigraphy of the 'auriferous conglomerate' suggests its identity with the 'Coos quartzite'—a formation traceable southerly into Massachusetts down the Connecticut valley. (7) The numerous fractures in this conglomerate indicate that the whole region is but a mosaic of faulted fragments. (8) This better understanding of the Ammonoosac rocks can not fail to improve our interpretations of the ages of the adjacent crystalline groups in northern New England.

*Studies in the Western Finger Lake Region:* Charles R. Dryer. (Illustrated with lantern slides.)

The region discussed lies in western New York, between Canandaigua Lake and the Genesee River. The northward slope of the Allegheny plateau is here trenched by deep, narrow valleys, four of which contain small lakes, while a fifth is lakeless. These valleys are similar in general character to those of the larger Finger lakes, but bear peculiar relations to one another and to the east-west Cohocton valley. In several cases the head of a minor valley opens broadly into the side of a major valley but a few hundred feet above its floor, thus sustaining the relations of a headward hanging valley. These are thought to furnish criteria for estimating the amount of differential deepening by ice erosion. The main valley heads are blocked by massive terminal moraines and overwash plains. The steep valley slopes are broken by rock terraces which support well-developed marginal moraines. Pitted or morainal deltas indicate the existence of high-level marginal lakes. Transverse passes and high-level longitudinal valleys are choked for many miles with morainal deposits terminating in an overwash plain. Some of the principal ridges present drumlinoid profile, while their lateral slopes were greatly oversteepened. The phenomena indicate that during the late Wisconsin period the region was occupied by a complex system of distributary and intercepting ice streams, to which the present depths and sharpness of the valleys are chiefly due.

*Note on the Geology of the Hellgate Valley between Missoula and Elliston, and Northward to Placid Lake, in Montana:* N. H. Winchell. (Read by title.)

This paper gives an account of the general stratigraphy extending from the oldest sediments (Algonkian) to the Cretaceous

and an approximate estimate of the thickness of the various formations. The region is marked by many faults and close folds, the axes mainly running northwest and southeast. The author makes a provisional identification of the Algonkian formations described further north by Willis, viz., the Kintla argillite, the Sheppard quartzite and the Siyeh limestone. The great limestone formation of the region, usually regarded as including the Carboniferous, is believed to extend downward so as to embrace the Devonian and the Trenton of the Lower Silurian. The Jura-Trias, as identified, contains a coal bed that promises to be of economic importance. The igneous phenomena are numerous and diversified, consisting of surface lava sheets, volcanic craters and volcanic ash, as well as dikes of gabbro, diabase, quartz-porphyry and granite. The oldest rocks constitute the highest relief of the country, the Cretaceous strata having been less disturbed, though the Cretaceous is probably older than the epoch of the principal volcanic action. One of the most important statements of the paper is to the effect that there seems to have been a practically continuous sedimentation from the Algonkian to the close of the great (Carboniferous) limestone.

*A Fossil Water Fungus in Petrified Wood from Egypt:* Alexis A. Julien. (Read by title.)

A description is given of a specimen of silicified wood from a 'petrified forest' near Cairo, and the mode of distribution of the fungus throughout the ducts. An interesting association of crystals of hematite and of pseudomorphs after gypsum and halite occurs, which testifies to the earlier conditions of petrification. The organic forms have been preserved in remarkable perfection and abundance. These are successively described, comprising discoid spores, an articulated macromycelium, macrosporanges enclosing sporules, micromycelium bearing three forms of stalked cells, and large ovate capsules carrying the spores first described, a continuous series which apparently represents the life history of the new organism. Its generic relationships and genetic local history are then discussed, with a review of various theories of the process of silicification.

*The Development and Relationships of the Rugosa (Tetracoralla):* J. E. Duerden. (Illustrated by lantern slides. Read by title.)

The paper gives (1) a brief historical account of the various theories which have been held with regard to the nature and relationships of the extinct Rugosa or Tetracoralla; (2) the conclusions of the author from the examinations of a large number of species in the light of more recent results on living corals. The present investigation has been carried on mainly by the method of grinding down of individual coralla, each successive stage in the growth being drawn as it appeared. In this way the complete development and relationships of the septa have been established. In every instance where the perfect tip has been preserved a cycle of six septa is found to occur, thus demonstrating the primary hexameral relationships of the Rugosa as contrasted with the tetrameral usually assumed. The subsequent septa appear in only four of the six primary chambers and in a manner differing altogether from that in modern corals. The conclusions reached are that the Rugosa must remain a distinct group of corals, related in their early stage to modern corals and actinians, but later developing in an altogether characteristic manner. Of modern forms they are most closely allied to the zoanthid actinians, which are without any true skeleton; in these the addition of the mesenteries takes place in a manner

comparable with that of the septa in the extinct forms, though proceeding in only two of the six primary chambers.

*The Sudbury Nickel-bearing Eruptive:* A. P. COLEMAN.

Field work carried on for two summers for the Bureau of Mines of Ontario has proved that the eruptive rock accompanied by nickel ores in the Sudbury District has a continuous outcrop enclosing an oval area forty miles by sixteen in extent, and dipping inwards on all sides. It is in reality a sheet of rock from one to three miles thick forming a boat-shaped basin, but having an eruptive contact with the rocks both above and below. Its outer, lower edge consists of norite and is much more basic than the inner, upper edge, which is a micropegmatite consisting mainly of alkaline feldspars and quartz. The nickel ore bodies are found arranged along the basic, outer edge or on irregular dike-like extensions of the norite which may reach six miles from the main body of the eruptive. One mine contains several million tons of ore. Most of the ore appears to have separated by gravitation from the still molten eruptive, but part has been deposited by circulating waters.

*The Widespread Occurrence of Fayalite in Certain Igneous Rocks of Wisconsin:* SAMUEL WEIDMAN.

In the central part of Wisconsin, within the area of pre-Cambrian rocks, is a large variety and abundance of igneous rock which intrudes a much older sedimentary series, and, in turn, lies beneath a later sedimentary series. These igneous rocks may be divided into three series; the oldest being rhyolite; the next, diorite, gabbro and peridotite; the latest, granite, quartz-syenite, nepheline, sodalite, and ægerite-syenites, and related rocks. In the last-mentioned series fayalite occurs as a persistent, though minor, constituent. Analysis of the fayalite is given. Also analyses of the rock varieties are given, showing a remarkably low content of magnesia, which does not increase as the content of silica in the series decreases. The alteration of the fayalite is to magnetic iron oxide. A brief account of the general occurrence of fayalite in other places is given. The various principal types of rock from Wisconsin, containing fayalite, with thin sections and photo-micrographs, are exhibited.

*Structural Relations of the Granites of North Carolina:* THOMAS LEONARD WATSON. (Read by title.)

Describes the occurrence, distribution and petrography of the North Carolina granites, with special reference to their structural and age relations. The numerous dikes of basic igneous rocks penetrating the crystallines of the Carolina Piedmont Plateau region are discussed in their relations to the jointed structure of the enclosing rocks, especially the granites.

*Field Work in the Wisconsin Lead and Zinc District:* U. S. GRANT.

During the summer of 1903 the Wisconsin Geological and Natural History Survey did some detailed mapping of selected areas in the southwestern portion of the state, which is part of the Upper Mississippi Valley lead and zinc district. In this field work the topographic and geologic mappings were carried on *pari passu* by the same individuals; the field sheets prepared were on the scale of eight inches to the mile, with ten-foot contour interval, and in publication the scale is to be reduced one half. While maps of this scale and detail will be valuable in themselves, it is hoped that they will give important results in working out the details of the relations of the ore bodies to the structure of the district.

*Molybdenite at Crown Point, Wash.:* A. R. CROOK. (Illustrated with lantern views.)

This locality furnishes the largest amount of molybdenite in the country. Twelve tons were produced in 1902. Mineral is found in fourteen different associations.

*Recent Studies in the Physiography of the Ozark Region in Missouri:* C. F. MARBUT. (Illustrated with lantern slides.)

Field work in the Ozark region during the past summer has demonstrated the existence of a peneplain lying at a lower level than that of the so-called Cretaceous peneplain of the same region. It is probably the same feature as the one described locally in Barry and Stone counties by Hershey in 1895. This paper describes its character in the south-central part of the Ozark region.

*The Physiography and Glaciation of the Western Tian Shan Mountains, Turkestan:* W. M. DAVIS and E. HUNTINGTON.

The existing ranges of the Tian Shan Mountains in central Turkestan result from the elevation and greater or less dissection of a more ancient mountain system that had been previously subdued or worn down to small relief over a large area. The elevation of the old-mountain region was accomplished in part with moderate deformation, in part with strong block-faulting. Local glaciation in several successive epochs is clearly recognized.

*A System of Keeping the Records of a State Geological Survey:* E. R. BUCKLEY.

Two classes of inquiries are received by a state geological survey, viz., (1) The mineral resources of a particular section of land and (2) the occurrence of a certain resource in a particular county. To answer these inquiries requires the collection and storing of a vast amount of information. The collecting of this information is gradually carried on by the usual field work of the survey and correspondence. The storing of this information in such a manner as to make it easily accessible is brought about by an adoption of the card catalogue system. A location case and a subject case are provided in which all data relating to the mineral resources of the state are recorded.

*The Tectonic Geography of Southwestern New England and Southeastern New York:* WILLIAM HERBERT HOBBS. (Illustrated with lantern slides.)

The paper discusses the important elements in the architecture of the earth's crust within the province designated, as a result of extensive surveys made for the U. S. Geological Survey. A number of 'key areas' were selected having regard both to the intricacy of their structure and to their distribution within the province, and studied with much detail. The structural elements characteristic of the individual areas were then compared and their relationship to the broader structural lines of the province as a whole considered. So far as possible the essential facts were set forth by means of maps projected upon the screen.

*The Lineaments of the Eastern United States:* WILLIAM HERBERT HOBBS. (Illustrated with lantern slides.)

This paper is an extension of the investigation upon the tectonic geography of portions of New England and vicinity, with a view to determining whether structures found to characterize that province are common to the larger regions as well. The materials of the study have been the topographic maps of this region and the published works of other geologists, the methods of examination and the point of view being, however, new.

*A Pre-glacial Peneplain in the Driftless Area:* U. S. Grant and H. F. Bain.

In southwestern Wisconsin and adjacent portions of Illinois and Iowa is a well-developed peneplain cutting across part of the Maquoketa shales, the whole of the Galena, Trenton, St. Peter and Lower Magnesian, and terminating to the north in a sharp scarp developed in the soft Potsdam sandstone. It rises gradually to the north. Above it are the so-called 'mounds' capped with Niagara limestone and forming monadnocks left in the dissection of an older peneplain. Below it the streams have cut valleys with sides of simple continuous slope. The valleys are arranged in normal dendritic fashion. Streams heading outside the area show terraces of glacial-derived material and their tributaries show commonly a low terrace developed by silting up of slack water. The peneplain represents the last great period of base-leveling before the oncoming of the glaciers. It was followed by one of sharp downward stream-cutting which continued apparently with but slight interruption through the Pleistocene to the present. Possible correlation of the peneplain with a similar one of Tertiary age in southern Illinois is discussed.

*The New Cone of Mont Pelé and Other New Features of the Mountain:* E. O. Hovey.

*Some Striking Erosion Phenomena Observed on the Islands of St. Vincent and Martinique in 1903:* E. O. Hovey.

The two papers announced in the above titles are essentially an exhibition of lantern slides illustrating facts brought out in recent publications.

*The Grand Soufrière of Guadaloupe:* E. O. Hovey.

This paper emphasizes by means of lantern views the idea that this cone has been formed in the same way as that of Mont Pelé.

*Domes and Dome Structure in the High Sierra:* G. K. Gilbert. (Illustrated with lantern views.)

In many dome-like granite hills the rock is divided into plates by curved joints approximately parallel to the surface. Some observers call the structure exfoliation, others regard it as an original structure of the granite. Under one view the surface forms determine the structure; under the other the structure determines the surface forms. A study of the High Sierra of California in the summer of 1903 has led the author to accept the former view, and to believe that the forms of the parting planes are conditioned by the forms of the topography. As to the cause of the phenomenon, the following hypothesis is advanced: Formed deep within crust, the granite was initially subject to compressive stress, which was balanced by internal expansive stress. As the unloading involved in subsequent denudation reduced the compressive stress, the unbalanced expansive stress caused strains which eventually resulted in exfoliation.

*The Trent River System and the St. Lawrence Outlet:* Alfred W. G. Wilson. (Read by title.)

The St. Lawrence River in the vicinity of the Thousand Islands crosses the Frontenac axis, a narrow neck of Archean rocks which connects the Adirondack region with the greater Archean areas of Canada. West of this axis, the country which lies to the north and east of Lake Ontario is underlain by flat-lying, Ordovician rocks, chiefly Trenton limestones. The drift cover of the area is very thin, averaging perhaps two feet in depth, while the relief has an average measure of at least one hundred and fifty feet. There are numerous areas where the bed-rock exposures are very ex-

tensive. In its present attitude the region is traversed by a number of southwest-flowing streams, running in broad, deep, rock-sided valleys. These valleys are older than the ice sheet which made the grooves on the bed-rock, and there is internal evidence to show that the amount of glacial erosion within the area has been very slight. The maturity of form, and the adjustments of these valleys, where they are not submerged beneath the waters of the present lake or obscured by morainic deposits, are regarded as indicating that they were eroded by the preglacial predecessors of the streams which flow in them. The form and adjustments of the valleys of the partly submerged portions of the limestone areas, particularly the Bay of Quinte and the present St. Lawrence outlet, suggest that these also are similar to those unsubmerged valleys which can be more readily and easily studied. It is concluded that these rock-sided valleys formed part of a now dismembered river system whose original general direction of flow was southwest; that the Trent River system occupies parts of no less than twenty of the tributary valleys of this system; and that the present St. Lawrence outlet from Lake Ontario, west of the Frontenac axis, consists of a complex of three of these ancient valleys in which the water is now flowing in a contrary direction to that in which it was flowing when the valleys were carved.

*Postglacial Changes of Attitude in the Italian and Swiss Lakes:* Frank Bursley Taylor. (Read by title.)

In the summer of 1894 the writer spent two weeks in exploring the shores of the lakes of northern Italy for evidences of change in the relative attitude of the lakes and the land. On Lakes Maggiore and Como no certain evidence of wave action was found above present lake level. But a study of the old deltas of the numerous torrents which descend from the mountains shows that the lakes formerly stood in different attitudes, with reference to the land, from those in which they stand to-day; and Lake Maggiore stood at a slightly higher level. The old deltas are fragmentary, but their form and structure show the former lake level with approximate accuracy. Since the change of attitude the streams have cut down to the present level and some of the larger torrents have well-formed valley terraces connecting with their old deltas and standing high above their modern floods. In the northern part of Lake Maggiore fine examples may be seen at Macagno on the east side and at Conobbio on the west. The valley terrace back of Conobbio is a well-marked feature. At Arona and Meina near the south end, the old lake level was nearly 20 feet above the present level, and it rises gradually to 50 or 55 feet near Locarno at the extreme north. The Ticino River below Lake Maggiore seems to have cut down the morainic barrier nearly 20 feet since the change of attitude. On Lake Como the old lake level at Cernobbio on the west side near the south end appears to be about the same as the present level and rises northward to 30 or 35 feet at Gravedona. On Lake Garda, along the western side of the southern part, a small but well-defined wave-cut beach was found descending from the eastern end of the peninsula southeast of Salo, where it is about 15 feet above the present lake level, very nearly to the present level at Desenzano. It is also well shown on the outer end of the peninsula near Sermione and on Isola di S. Biagio and other small islands. The east side of the expanded portion of the lake was not explored. In the narrower northern part there are deltas near Riva like those of Lake Maggiore, and a few also along the eastern side. These seem to indicate a former lake level at the north end 30 or 35 feet higher than the

present. Thus, on each of the three lakes there are remains of an old lake surface which rises in a northerly direction about one foot per mile as compared with the modern surface. Lake Geneva in Switzerland was also studied for the same evidences. Sandy deposits apparently marking an old beach were found at Lausanne 12 to 14 feet above the present lake level. The paper then discusses briefly the significance of these facts and of similar facts in other parts of the world.

*The Basin of the Po River:* George L. Collie. (Read by title.)

The paper is the result of field work done on the Po plain in the spring of 1903. The basin of the Po was an arm of the sea during the Miocene; a portion of the time probably a strait connecting the Adriatic with the Mediterranean, through the present Col d'Altare. The sea was gradually crowded out by the encroachment of sediments, brought in from the Alps to the north and from the Apennines to the south. Sediments from Alpine sources are coarse; from Apennine sources, fine. The total area of the basin is 27,000 square miles, of which 16,000 square miles are mountainous and 11,000 square miles belongs to the plain of the Po. Borings in the plain show that it is composed of a series of approximately horizontal sands, clays and marsh deposits, the last including lignitiferous clays. The sands contain marine shells, the clays carry land shells. The whole succession indicates alternation of marine, fresh-water and land conditions. The thickness of the deposits ranges from 572 to 695 feet. There is little fine alluvium in the upper Po, the river flowing over coarse deposits; but below the Sisera River alluvium of a fine type is common. The upper Po is everywhere crowded close to the northern spur of the Apennines, forced over apparently by the large and heavily laden tributaries from the Alps. In times of flood the river carries an immense amount of debris, estimated to be one three-hundredth of its volume. In spite of this heavy load, the river is not aggrading its bed to an appreciable extent. This non-aggradation is due in large measure to the lake system of northern Italy, which drains into the Po and supplies it with four tenths of its water content. During periods of high water in the fall and spring, the sediment-laden streams from the Alps bring their load to the Po and deposit it. The lakes, however, being basins of reception, not only take out the sediments from the drainage, but also store the water and supply it more gradually than do the lakeless streams. Lago di Garda, in time of great rainfall, scarcely changes its level; the small lakes, such as Como or Maggiore, show great changes of level within a few hours, but, on the whole, they all tend to restrain the water. The result is that after the debris-laden streams have deposited their sediments in the Po and temporarily raised its bed, later there comes a volume of comparatively clear water which removes the previous accumulations, and an equilibrium is maintained on the whole. The Po is thoroughly diked from Cremona to the marshes of the delta. It is customary to place the froldo or main dikes at some distance from the river, thus allowing the river to overflow the intermediate flood plain or golene for some distance before reaching the dikes. The golene are frequently covered with willows and thick underbrush and the velocity of the current is greatly reduced thereby and there is little active erosion upon the dike itself. The dikes are continually being extended; the extension of dikes accounts in a measure for the rapid extension of the delta in modern times. Between 1200 and 1600 A. D. the delta advanced on the average about 70 feet annually; for the last few

decades, its advance has been at the rate of about 200 feet annually. The flood plain deposits of the upper Po are cross bedded and very irregular; the beds are chiefly cobbles, coarse gravel and pebbles; occasionally wedges of sand are thrust in, the latter of limited extent. The beds show great variations in size of materials; there are sudden changes from coarse to fine gravel, and *vice versa*. The beds are not continuous over wide areas; generally there is a change in composition and texture every few rods. Occasionally there are local deposits of silt and clay, stratified as a rule, which cover a few acres. One of these deposits in the environs of Turin covers forty acres. On the lower Po the flood plain deposits are much finer in texture and show more regular arrangement than those quoted above. Much of the material is silty clay and fine sand. Laminated structure is common, the thin laminæ extending for several hundred feet, but invariably replaced sooner or later by sediments of different texture or composition. When long sections are exposed so that they can be seen *ensemble*, it is noticeable that the beds undulate. Strictly speaking, there is no horizontality of beds, but rather a slow rise and fall. Long, flat augen of sand are the apparent cause of this arrangement. These flat lenses occur frequently, the finer sediments wrap them about, and the bedding of the latter is made to show corresponding undulations. The degree of undulation is determined by the thickness and length of the sand lenses.

*Nantucket Shore Lines, II.:* F. P. GULLIVER. (Illustrated with lantern views.)

During the past year the writer has continued his studies of the recent changes in the shore lines of the island of Nantucket, and the results of such study are given in this paper. Details of changes are presented in the following areas: Great Point, Coskata, Haulover Break, Surfside, Maddaket, Smith Point, Brant Point, Nantucket Harbor and Coatue. Original plane table surveys are given of Miacomet foreland, at Surfside, where sand has been built out some 1,500 feet in the last forty years in one of the most exposed portions of the island, while extensive cutting back has taken place both east and west of this foreland; and also of Smith Pond, where the shore line is rapidly moving to the north. Since the break was made in the tombolo at the head of the harbor connecting Coskata Island with the eastern end of Nantucket, in the winter of 1896–7, at the point where the fishermen formerly hauled their boats over the sand, there have been many changes in the shore lines. The facts in regard to these changes have been collected from government surveys and many private sources, and a series of outline maps prepared.

*The New Geology under the New Hypothesis of Earth Origin:* HERMAN L. FAIRCHILD.

A theoretical discussion of the geologic bearings of the planetessimal hypothesis. A brief comparison is made between the two conceptions of earth genesis, and it is shown how the nebular hypothesis has failed to explain phenomena and has been a hindrance to the progress of geologic science. Some of the topics discussed are, origin of the atmosphere, origin of the ocean, volcanic phenomena, source of hydrocarbons, geologic climates, diastrophic movements, life on the earth.

*The Humboldt Region; a Study in Basin Range Structure:* G. D. LOUDERBACK.

*Glacial Erosion in the Finger Lake Region, New York:* M. R. CAMPBELL. (Read by title.)

The Finger Lake region of New York is an ideal field for the study of the effect of glacial erosion, presenting as it does simple

geologic conditions free from complicated structure and possessing fairly well-marked topographic forms from which its physiographic history may be interpreted. The present paper is the result of an effort to make a systematic study of the physiographic features of this part of the state, and it is based largely upon a careful study of the contoured topographic maps that have been assembled and reproduced here for the first time. The author has approached the question free from any bias regarding the ability of glaciers to accomplish extensive erosion, and has dealt with the problem entirely from the physiographic standpoint; an effort was made first to account for the present topography largely through the simple process of subaerial erosion, but this failed to explain the peculiar features of the region. The conclusion arrived at is that ice was the principal agent in not only giving the finishing touches to the present topography, but in the extensive erosion which has reduced this portion of the state from an altitude of approximately 2,000 feet to that of 800 or 1,000 feet above sea level, and that has produced the great topographic embayment of the Finger Lake region.

*Evidences of Slight Glacial Erosion in Western New York:* H. L. Fairchild.

*Waning of the Glaciers of the Alps:* H. L. Fairchild.

Lantern views from photographs taken during the past summer illustrating the decrease of the Alpine glaciers within recent years.

*The Carboniferous of the Appalachian Basin; Part II., the Pottsville:* J. J. Stevenson. (Read by title.)

*Notes on the Deposition of the Appalachian Pottsville:* David White.

General view of the thickness and present distribution of the main divisions of the Pottsville sediments in the Appalachian trough. Extent and duration of the basal uniformity as indicated by fossil plants. Suggestions as to conditions of deposition of the several divisions.

*The Benton Formation in Eastern South Dakota:* J. E. Todd.

*Further Studies of Ozark Stratigraphy:* C. F. Marbut.

During the past summer the reconnoissance mapping of the formations of the Ozark Series was extended over the south-central counties of the state. The paper will describe the character and distribution of the various formations, and discuss briefly the evidence on which the correlation is based.

*The Iroquois Beach in Ontario:* A. P. Coleman.

The detailed mapping of the Iroquois Beach in Ontario was begun in 1898 and practically completed in 1902, but publication was delayed in hopes of extending the work northeast from Havelock, the last point at which the beach could be found. As it can be traced no farther, it is probable that the shore to the east and north consisted of ice. The highest point reached is 498 feet above Ontario or 744 feet above the sea. Northeast of Colborn it is split up into several beaches, in one case the highest being 80 feet above the lowest; but southwest to Hamilton the beach is practically a unit, and the same is true on the south shore to Niagara River. There is evidence of the splitting up of the water levels at Toronto and Hamilton in the form of old surfaces of erosion, soils with trees, and remains of mammoth, etc., at levels from 30 to 80 feet below the gravel bars representing the latest Iroquois lake levels. It is believed that the evidence obtained proves that the Iroquois water was a lake with an ice barrier to the northeast, and not an arm of the sea.

*Evidence of the Agency of Water in the Distribution of the Loess in the Missouri Valley:* GEORGE FREDERICK WRIGHT.

The paper is the result of field work conducted during the past year in the vicinity of the Missouri between St. Joseph and St. Louis. The direct evidence of the agency of water in distributing the loess is found: (1) in the relations of the loess to the main valleys of the Missouri and its larger tributaries; (2) the existence of distinct laminæ, at a height of 180 feet above the river at St. Joseph, which are very clearly of water origin; (3) the new light shed upon the glacial occupation of the region by the discovery of northern drift on the south side of the Missouri River forty miles beyond the boundary which has heretofore been assigned to it; (4) considerations which show the doubtful character of the conclusions drawn from the fossil shells found in the loess; (5) calculations showing the reasonableness of the supposition that at the close of the Iowan stage of the glacial period there were periodical floods each summer sufficient to cover the whole region occupied by the great body of the loess, and the presentation of a theory that would seem to harmonize all the facts.

*The Loess at St. Joseph.* (Illustrated by lantern slides.) Read by Professor G. Frederick Wright for Luella Agnes Owen.

Exposures of undisturbed loess in cuts at a variety of elevations are described. Several of the highest are distinctly stratified and the horizontal strata, in places, regularly banded with iron stain. Fossil snail shells of the two forms common to the loess are abundantly distributed throughout these high-level laminations. The iron bands can be accounted for by aqueous deposition, but the æolian theory does not so readily offer a solution of their presence and regularity. Objection to the glacial origin of loess has depended largely for support on the absence of an adequate barrier on the south and west to have retained a body of water of sufficient depth for the deposition of the higher portions of the bluffs. Such a barrier, however, can be shown to have existed and to still remain, by giving attention to the elevations of the tributary water-sheds in those directions and to the known conditions during the flood period in May of 1903. Authority is quoted to the effect that snails can not be identified by the shells alone, as the same kind may be common to forms of radically different organization; and the shell, therefore, is entirely subordinate to differences in structure of the animal. If this is true, the æolian theory suffers the loss of its best support.

*Fresh-water Shells in the Loess:* B. SHIMEK.

1. A review of the available literature in which reference is made to the occurrence of fresh-water shells in the American loess, with a discussion of the significance and weight of such testimony, showing that as yet no well-authenticated cases of the occurrence of fluviatile shells, at least in original loess, are known.

2. A statement of the author's own experience in the study of loess mollusks, which shows that land shells greatly predominate, and that only such fresh-water forms as inhabit temporary small ponds and streamlets occur in the loess, and these in relatively small numbers.

*Comparison of the Stratigraphy of Black Hills, Big Horn Mountains, and Rocky Mountains, Front Range:* N. H. DARTON. (Read by title.)

GEORGE B. SHATTUCK,
*Secretary.*

JOHNS HOPKINS UNIVERSITY.

*THE METRIC SYSTEM.*

In the current issue of Science (March 4) Mr. Alfred C. Lane has presented some useful hints with a view to facilitating the popular adoption of the metric system in America. His chief points are the adoption of the metric ton as the standard of mass, the definition of the standard pint as the volume of a half-kilogram of water under standard conditions, and the definition of the foot as the length of the edge of a cube whose capacity is 62.5 pints. This last definition is said, in an appended note, to be not essential to the scheme.

In any system of metrology the unit of length is that to which all other units are finally referred, unless these are so arbitrary as to preclude the use of the word 'system.' The essentials of any desirable system are simplicity and consistency. An ideal system is that developed a century ago in France and now employed by all scientific workers, but not yet popular with the masses in English-speaking countries. The problem of conferring popularity upon it is one that will require many years yet for its solution.

Whatever may be the form taken by legislation in England and the United States, the people can not be compelled to adopt nomenclature that is thrust upon them as a substitute for that to which they have always been accustomed. The nomenclature must be simple in order to secure adoption; it must be at least fairly in harmony with old customs in order to win favor. For many centuries past the foot has been by far the most popular unit of length, though the range of variation in its value has been 165 per cent. of the smallest magnitude to which the name was applied. In like manner the pound has been the popular unit of weight, with as many as 235 variations in value. The use of these names in different languages is popularly maintained, even in countries, like France and Germany, where the metric system is legally established.

If the metric system is ever to become popular in the United States it must be through the medium of such legislation as will give us its substance with as little as possible of its nomenclature. Its essential features are:

1. A decimal relation between all the units employed.

2. A direct and simple relation between units of length and mass.

In view of the strong influence of old customs we can not expect a new system to be inaugurated that is exclusively decimal. If the people are accustomed to binary or duodecimal subdivision they will hold to it in spite of legislation. All of us are disposed to do what we find easiest. Nor is there much reason to expect that all units of length and mass will be discarded except those connected by the simplest relation. Ideas may differ as to what is simplest, and in any case there will be a survival of what the populace finds fittest, irrespective of the prescriptions of theory. The introduction of the metric system can be accomplished only by some sort of compromise, through which old names may be retained while the values of the corresponding magnitudes are slightly modified for the sake of simplicity.

Everybody understands that by a process of selection the once chaotic British system has been becoming simpler. Many units that were in use a half century ago are now obsolete, though the inconvenient relation between those still surviving is bad enough and incapable of much improvement. By still further excision, by adoption of a few names and values from the metric system, and by such modification in existing values as will produce no great inconvenience, we may quite reasonably hope for such practical adoption of a decimal system as to

satisfy all the demands of international commerce.

It should be remembered that by act of congress, April 5, 1893, the international standard meter and kilogram were adopted as the standards of length and mass, respectively, for the United States. The yard and the pound are now legally defined as merely definite fractions of the meter and the kilogram. The following outline of an American system of metrology has occurred to me as perhaps capable of adoption. Some, if not all, of its features must have occurred to many of the advocates of metric reform.

1. Let the length of the yard be changed by legal enactment so as to coincide with that of the standard meter.

2. Let the foot be defined as the fourth part, instead of the third, of a yard. Let it be divided into ten instead of twelve inches. The length of the inch will thus be changed by less than two per cent.

3. Let the pound be defined legally as one half of a kilogram.

4. Let the quart be defined legally as the volume of a kilogram of water under the usual standard conditions. The quart and the liter become thus identified.

5. Let the ton be defined as 1,000 kilograms. The American and metric tons are thus identified.

6. Let the pint, gallon, peck and bushel be retained as secondary units, each being defined in terms of the quart.

The latter part of this scheme, it will be observed, is identical with a part of that proposed by Mr. Lane, but the first part differs quite radically from his. The following tabulation constitutes a summary for measures of length, mass and capacity, respectively.

UNITS OF LENGTH.

| | | | | |
|---|---|---|---|---|
| 1 meter | = 1 yard | = 100 | centimeters | = 1,000 millimeters. |
| 1 inch | = 1/40 yard | = 2.5 | " | = 25 " |
| 1 foot | = 10 inches | = 25 | " | |

UNITS OF MASS.

| | | | |
|---|---|---|---|
| 1 kilogram | = 1,000 grams. | | |
| 1 pound | = ½ kilogram | = 500 grams. | |
| 1 ton | = 1,000 kilograms | = 2,000 pounds. | |

UNITS OF CAPACITY.

| | | | |
|---|---|---|---|
| 1 liter | = 1 quart | = volume of | 1 kilogram of water. |
| 1 pint | = ½ " | = " | " 1 pound " " |
| 1 gallon | = 4 quarts | = " | " 8 pounds " " |
| 1 peck | = 8 " | = " | " 16 " " " |
| 1 bushel | = 32 " | = " | " 64 " " " |

This table includes about all of the units needed for most of our measurement. Units of area and volume need no definition. For land measure the mile as unit of length and the acre as unit of area will probably last many years yet. They have no place in international commerce, the needs of which constitute the most important ground for changing the units hitherto in use. No mere theoretic consideration will be apt to influence legislation.

The scheme just outlined presents the advantages of both the decimal and the binary systems of subdivision. In practise halves and quarters are much the most important of the binary subdivisions. In our decimal system of American money the only sudivisions of the dollar that now survive are the half, quarter, tenth, twentieth and hundredth; though eighths and sixteenths seem to have been once coined, and were found more confusing than useful. The division of the foot into tenths rather than twelfths is in accordance with custom now well established among engineers and surveyors. The binary subdivision of the inch may be retained as long as found useful, while the centimeter will be divided into both halves and tenths.

It will be noticed that while some of the secondary British units are retained, especially those with binary relation to the primary unit, the ounce, dram, pennyweight, scruple and grain are all discarded. There has been but little use for these outside of the pharmacy and the mint. The retail dealer uses halves and quarters of a pound. All educated pharmacists to-day

have learned the metric system. They need no weights but the gram with its decimal multiples and divisions. The ounce ought long ago to have been abolished or defined as a definite fraction of the avoirdupois pound alone. Its abolition is much preferable to its retention.

An obvious advantage of dividing the foot into 10 inches is that a cubic foot becomes 1,000 instead of 1,728 cubic inches. The weight of the cubic foot of water becomes 31.25 pounds according to the suggested definition of the pound. The reduction in length to 10 inches, furthermore, makes it coincide very closely with the length of the average masculine foot, while 12 inches is more than twenty per cent. too long.

The suggested length of the inch is between one per cent. and two per cent. less than that of the present inch. Small as this change may be, it constitutes the most serious of all the changes suggested. The practical standard of length in the United States has been, not the yard or foot, but the inch. In the construction and use of all machinery inches and fractions of an inch are the units of measurement. If a screw-thread has been cut in accordance with a gauge based on the inch, a change of two per cent. in the inch would render such a screw worthless for the same machine. The mechanical engineers and machine manufacturers will, therefore, continue to be the most determined enemies of metric reform. Should legislation be adopted involving a change of standards, a generous allowance of time ought to be provided, within which the machinists may adapt new instruments to the new standards. Few, if any, machines can be expected to continue available more than ten years. Such a period of grace would, perhaps, be as much as could be reasonably demanded.

The pound equal to half a kilogram is about one tenth greater than the avoirdupois pound. It is identical with the German *pfund* and the French *livre*. Its adoption by England and the United States would make the pound a definite unit readily understood throughout most of the civilized world. It is now indefinite.

Assigning the qualifier 'metric' to the proposed units to distinguish them from the old ones now in use in the United States, their mutual relations are approximately shown in the following table:

| | | | | | |
|---|---|---|---|---|---|
| 1 | metric | yard | = 1.0936 | old | yard. |
| 1 | " | foot | = 0.8202 | " | foot. |
| 1 | " | inch | = 0.9842 | " | inch. |
| 1 | " | pound | = 1.1023 | " | pound. |
| 1 | " | ton | = 0.9845 | " | long ton. |
| 1 | " | quart | = 1.0567 | " | wine quart. |
| 1 | " | pint | = 1.0567 | " | wine pint. |
| 1 | " | gallon | = 1.0567 | " | wine gallon. |
| 1 | " | peck | = 0.9081 | " | peck. |
| 1 | " | bushel | = 0.9081 | " | bushel. |

It is, of course, understood that the proposer of any change whatever in the units to which the American public is accustomed will be adversely criticized, particularly by the mechanical engineers and the manufacturers of machine tools. Such criticism can be borne with equanimity if the compromise scheme just outlined should lead to the practical adoption of the metric standards and the decimal system of weights and measures, with a reasonable combination of the binary system with it. The decimal system of coinage a century ago was regarded by some critics as visionary, but it has stood the test of time.

W. LeConte Stevens.
Washington and Lee University.

## THE AUSTRALASIAN ASSOCIATION.

The biennial meeting of the Australasian Association for the Advancement of Science was held this year at Dunedin, New Zealand. There was a large attendance of members from all the Australasian colonies

and the efforts of the general secretary, Mr. G. M. Thomson and his committee resulted in a highly successful gathering. The arrangements were satisfactory to the visitors, who were well entertained by the resident members and other citizens.

The generous action of the New Zealand government in granting free railway passes to all visiting members was probably in part responsible for the large attendance.

The address of the president, Professor T. W. Edgeworth David, was delivered on Wednesday, January 6, and the meeting was not concluded until January 13. In his address the president reviewed before a large audience the general advance of all branches of science in southern lands. He strongly encouraged those who are at present engaged in scientific work to redouble their efforts and pleaded that the minds of the young might be so trained in the colonial schools that they may be capable and eager to take up research work in their turn.

On the following day the members were divided into the following sections: A, Astronomy, Mathematics and Physics; B, Chemistry; C, Geology; D, Biology; E, Geography; F, Anthropology; G1, Social Science; G2, Agriculture; H, Architecture and Mining; I, Sanitary Science; J, Mental Science and Education.

The president's address in Section A was an able summary of some recent advances in the theory of the ionization of gases. Professor Brogy, of Adelaide, dealt with his subject in such a manner as to keep his large audience thoroughly interested throughout. On the following day an interesting discussion took place on tidal observation and it was pointed out that New Zealand occupied a very favorable position for such observations. Many other papers were contributed, including one from Professor Rutherford, of Montreal, on the heating effect of radium emanations.

In Section B the president, Mr. Henderson, gave an address on 'Chemistry and Food,' dealing particularly with the adulteration most frequently found in ordinary food substances. Amongst the papers was an interesting research on the acids contained in the resins of some of the New Zealand coniferæ by Professor Easterfield.

Mr. Twelvetrees in his presidential address to Section C dealt with 'Some Aspects of Modern Petrology.' The present confused state of petrological classification was particularly discussed and the president stated that though all systems hitherto proposed had glaring defects he could not believe that the new classification lately proposed in America would be the one finally adopted. Mr. Andrews described some of the glacial features of southern New Zealand, dealing with them in the manner so ably initiated by Professor Davis. Dr. Marshall read a paper on some of the highly interesting alkaline rocks near Dunedin. Some committees' reports were read on 'Glacial Phenomena in Australasia' and important structural features in Australasia and on the possibility of a uniform system of nomenclature in petrology. In the last there were as many divergent views as members.

In Section D the president dealt with the avifauna of Australasia, Polynesia and Austro-Malaya. Amongst many interesting papers were Dr. Chilton's on 'Subterranean Crustacea of New Zealand'; Dr. Fulton's on the habits of the long-tailed cuckoo and Mr. Steads's studies of New Zealand bird life. The nesting habits of these were dealt with in many beautiful photographs.

Anthropology in Section E opened with an address by Professor Baldwin Spencer on 'Totemism in the Central Australasian Tribes.' This was listened to with marked attention even by members who were not otherwise specially interested in anthro-

pology. Other papers were read on Maori folk-lore and studies on various southern languages.

'The Influence of the Southern Ocean on Australasian Climates' was the presidential address of Professor Gregory in the geography section. The effect of oceanic circulation upon weather conditions and the occurrence of weather cycles were the two points most strongly insisted on. Mr. Bowen gave a highly interesting account of the work of the *Discovery* in the South Seas, illustrating his remarks by lantern slides prepared from photographs taken by the expedition.

Agriculture in Section G2 dealt with highly practical matters. The president, Mr. Cato, chose for his subject 'Pomology.' Mr. Gilruth read an important paper on 'The Effect of Injection of Non-pathogenic Cultures with Virulent Ones of Anthrax.' He showed that the anthrax was under certain conditions rendered quite innocuous by this means.

In the architectural section the president, Mr. Deane, dealt with 'Day Laborers on Government Works.' This attracted much attention because of the many instances of colonial governments doing their own contracting.

In the sanitary science section Dr. Tidswell, in dealing with the hygienic action of boric acid, spoke strongly of the deleterious effect that this acid has even when used in small quantities as a preservative of dairy produce.

The education section was the best attended and a larger number of papers was presented to it than to any other section. The discussions evoked in many cases were animated. The president dealt with elementary education in Queensland, and there were papers on the teaching of modern languages, mathematics, geography, etc., and the discussions will probably do much towards the adoption of modern educational methods in Australasia.

Besides the formal meetings of members the association had provided numerous excursions to the many points of scenic or scientific interest in the neighborhood of Dunedin. The botanists were much interested in the abundance of the endemic New Zealand flora still to be found near the town. The geologists viewed and collected from the outcrops of the rare and peculiar alkaline rocks that occur in the Otago Peninsula in such profusion.

Several of the leading citizens of the town entertained the visitors by drives into the country and at afternoon parties at their residences and enabled the workers in various branches of science to meet in social intercourse.

P. Marshall.

Otago University.

## SCIENTIFIC BOOKS.

*Aboriginal American Basketry: Studies in a Textile Art Without Machinery.* By Otis Tufton Mason. From the Report of the U. S. National Museum for 1902, pp. 171–548, with 248 plates. Washington, 1904.

A number of influences have been operating for ten years or more to arouse an interest, both scientific and popular, in the basketry of the American Indians. Our museums have sent their representatives far and wide in the search for types, and the competition of private collectors has resulted in a species of basket hysteria which shows no particular signs of abating. This interest, however aroused, is widespread and real and has at last found fitting expression in the sumptuous memoir on the subject which has just appeared from the pen of Otis T. Mason. Professor Mason has long ranked as the leading American authority on primitive industries and technique and there was no one so well equipped as he to undertake the task of collecting and reviewing the results of the scattered studies which have recently been accumulating at a rapid rate. He has acquitted himself admirably.

Primitive basketry is of interest chiefly from two aspects, namely, method of manufacture and decoration. Both phases are considered in the present work and are naturally given the lion's share of attention, but nothing which has to do with the subject in hand seems to lie outside the scope of the book. From the mental attitude of the woman who weaves to the use to which her product is put, all is fish to the genial author's net.

Professor Mason's general point of view is geographical and wisely so. There is no other method which would permit a survey of the disparate phases of his subject without hopeless confusion. His classification, avowedly arbitrary and determined by the available material, is:

1. Eastern region: Canada, Eastern States, Southern States, Western States.

2. Alaskan region: Interior Alaska, Arctic Alaska, Aleutian Chain, Southeastern Alaska, Queen Charlotte Islands.

3. Fraser-Columbia region: Fraser drainage, Columbia drainage.

4. Oregon-California region: Southern Oregon, California.

5. Interior Basin region: Southern Oregon, California.

6. Middle and South American region: Mexico, Central America, eastern and western South America.

Varieties of basketry, materials used (including a botanical list by Mr. F. V. Coville), methods of manufacture, methods of ornamentation, symbolism, uses of basketry, distribution of types, collectors and collections, and bibliography are all treated in successive chapters and supplemented by a superb series of 248 plates, many of which are reproduced in color. The result is a monograph incomparably the best in the field and one destined to stand as a high authority for years to come.

It would be too much to expect a work of such compass to be equally good at all points and it must be admitted that some of the chapters are much more satisfactory than others. The author disarms criticism to a great extent, however, by his very frank recognition of certain shortcomings.

As indicated above, the two points of chief interest are technique and ornament. In his chapters on methods of manufacture and distribution of types the author is at his best. They are both notable contributions to our knowledge. His descriptions of technique are so clear and accompanied by such a profusion of illustrations of stitches and weaves that little is left to be said. Similarly with the distribution of types. This is a matter of great ethnological significance and its treatment is thoroughly good. Museums and private collectors far and wide have been drawn upon for material, and the result is an exhaustive mass of information for which all ethnologists will be devoutly thankful.

With the sections on ornamentation and symbolism the author reaches his difficulties. These problems have been attracting attention for years. The development of geometric patterns from pictorial designs has long been recognized, and from the nature of the materials this geometric ornamentation reaches its greatest complexity in basketry. The main problem has shifted of late from that of how far geometric patterns have arisen from realistic designs to that of how far meanings are read into designs already conventional. That this latter is a widespread tendency is certain. Designs and types of designs are borrowed and borrowed widely and the symbolic significance of these same patterns on foreign soil is quite as rich as though totally different from that obtaining in the groups of their origin. Culture and temperament determine the meaning even if not the form.

The extent of this process is the present problem at issue and a necessary preliminary to its solution is an extensive study of the local distribution of types of patterns without regard to their interpretation. The tracing of pattern elements, say from California, northward through the Shahaptian to other stocks north and east would yield much. Such a research has never been made, and although he recognizes its necessity, Professor Mason does little more than touch upon it. It is greatly to be deplored that one so well fitted did not accomplish for ornament what he has done for technique, but the author's

explicit avowal that his primary concern is with the practical and not the esthetic stifles complaint while it leaves regret. Fortunately the splendid series of plates affords material for a study of this character which has never before been available to any one to whom our large museums are inaccessible.

Filled as they are with descriptive detail, Professor Mason's pages do not lend themselves to quotation in a notice of this character. The scope of his work has been indicated. Suffice it to say that it is a big book and a good book and we are grateful.

Livingston Farrand.

Columbia University.

*The Paleontology and Stratigraphy of the Marine Pliocene and Pleistocene of San Pedro, California.* By Ralph Arnold. Memoirs of the California Academy of Sciences, Vol. III., pp. 420, pls. 37, 4to.

This memoir is the most important contribution to the invertebrate paleontology of the west American Cenozoic that has appeared since the publication of Gabb's 'Paleontology of the California Survey.' The author has worked very carefully over both the stratigraphy and the paleontology of the marine Pliocene and Pleistocene of California, obtaining more satisfactory results than have been reached by previous workers in paleontology. The field and laboratory work upon which the paper is based occupied the author for a large part of his time during nearly six years and every problem which presented itself has been carefully worked out to the minutest details. The paper was prepared at Stanford University, where the work was carried on under the able supervision of Professor James Perrin Smith.

The memoir is divided into two main divisions: Part I., a general discussion of the stratigraphy, faunal succession and faunal geography; Part II., a purely zoological discussion of the numerous forms represented in the faunas. Over four hundred species of invertebrates were obtained and this large number gives more than ordinary weight to the conclusions drawn by the writer.

The Pleistocene formations occurring at San Pedro have been designated by Dr. Arnold as the San Pedro series. This is divided into an upper and a lower division, which are separated by an unconformity. The fauna of the lower San Pedro includes 247 species, of which 12.5 per cent. are extinct. Of this number 64 per cent. of the species are now living at San Pedro, 17.4 per cent. are living only north of San Pedro, 3.2 per cent. only south of San Pedro. The conclusion is drawn that this is a cold-water fauna. The upper San Pedro fauna includes 252 species, of which 9.5 per cent. of the species are extinct. Of this number 68.2 per cent. are now living at San Pedro, 6.1 per cent. only north of San Pedro, 14.2 per cent. only south of San Pedro. The fauna of the upper San Pedro series more nearly resembles that found living on the Pacific Coast two or three hundred miles south of San Pedro. In other words, this is a warm-water fauna.

In addition to a careful discussion of the extensive series of species described from San Pedro, the author has studied a large number of other Pleistocene localities on the coast of California and has presented a valuable correlation table.

The author makes an interesting comparison of the faunas of the Californian and Japanese coasts in Pleistocene time, and has brought out the fact that the relationship was much closer then than it is now. As the lower San Pedro fauna of California is boreal, it is to be supposed that the northern fauna would also push down the Asiatic coast. In addition to this, the presence of a broad submarine shelf would make possible the interchange of species.

In Part II. of his paper Dr. Arnold has described many new and important species. He has made an equally important contribution in the redescription and figuring of a large number of species which have never been satisfactorily described or figured. This portion of the memoir will be of almost as much value to students of recent and Tertiary faunas as it will be to those who interest themselves in the life of the Quaternary.

The author and the editorial staff of the California Academy are to be congratulated

on the very satisfactory form in which the memoir appears. The arrangement of the material, the typography and the character of the illustrations are all worthy of favorable comment.

JOHN C. MERRIAM.

## SCIENTIFIC JOURNALS AND ARTICLES.

THE contents of the April number of the *American Journal of Mathematics* are as follows:

HENRY LEWIS RIETZ: 'On Primitive Groups of Odd Order.'

A. N. WHITEHEAD: 'Theorems on Cardinal Numbers.'

T. J. I'A BROMWICH: 'The Caustic, by Reflection, of a Circle.'

HARRY WALDO KUHN: 'On Imprimitive Substitution Groups.'

THE *American Journal of Psychology* for January contains the following articles:

W. P. MONTAGUE: 'A Theory of Time-Perception.'

BENJAMIN RICHARDS ANDREWS: 'Auditory Tests.'

E. B. TITCHENER: 'Some New Apparatus.'

I. M. BENTLEY and E. B. TITCHENER: 'Ebbinghaus' Explanation of Beats.'

C. SPEARMAN: 'The Proof and Measurement of Association Between Two Things.'

I. M. BENTLEY: 'Professor Cattell's Statistics of American Psychologists.'

THE first number of the *Journal of Comparative Neurology and Psychology* as recently reorganized appears in March with contents as follows: 'The Relation of the Motor Endings on the Muscle of the Frog to Neighboring Structures,' by John Gordon Wilson. A description with illustrations of the motor nerve endings with special reference to the ultra-terminal fibrils and the relation of the ending to the sarcolemma. 'Space Perception of Tortoises,' by Robert M. Yerkes. A quantitative study of the amount of hesitation exhibited by different species of tortoises before crawling over the edge of an elevated board and correlation of these data with the natural habits of the species studied. 'A Note on the Significance of the Form and Contents of the Nucleus in the Spinal Ganglion Cells of the Fœtal Rat,' by Shinkishi Hatai. A cytological examination of developing spinal ganglion cells to determine the functional significance of the centrosome, aster and Nissl granules and their relations to the nucleus, illustrated by two plates. 'An Establishment of Association in Hermit Crabs,' by E. G. Spaulding. A demonstration that the hermit crab is capable of profiting relatively rapidly by experience. Editorials, a summary of the neurological papers read at the mid-winter meetings and reviews complete the number.

THE March number of the *Botanical Gazette* contains a contribution from John F. Garber on 'The Life History of *Ricciocarpus natans*,' the investigation having resulted in a very complete morphological study, to which are appended biological data derived chiefly from observation of the plant in the field during one season and from experimental work in the laboratory.—Mabel L. Merriman publishes the results of her long study of 'Vegetative cell division in *Allium*,' this being one of the few complete studies of karyokinesis in vegetative cells of plants.—John Donnell Smith publishes his twenty-fifth paper entitled 'Undescribed plants from Guatemala and other Central American republics.'—Charles Thom describes *Craterellus taxophilus* as a new pecies of Thelephoraceæ.—J. M. Greenman publishes notes on the indigenous Centaureas of North America, describing one new species.—W. J. Beal makes another contribution to the vitality of seeds.

## SOCIETIES AND ACADEMIES.

### THE AMERICAN PHILOSOPHICAL SOCIETY.

THE general meeting of the society will be held on April 7, 8 and 9, in the hall of the society in Independence Square (104 South Fifth Street), Philadelphia.

Morning sessions, 10:30 A.M. to 1 P.M. Afternoon sessions, 2 to 4:30. Luncheon will be served in the rooms of the society from one to two o'clock. A reception will be given to the members and the ladies accompanying them at the Free Museum of Science and Art of the University of Pennsylvania on Thursday evening, April 7. The visiting members will be the guests of the resident members of

the society at dinner on Friday evening, April 8. The University Club, 1510 Walnut Street, extends the courtesies of its house to the visiting members during their stay in Philadelphia.

The preliminary program is as follows:

Dr. Charles Conrad Abbott, of Trenton, N. J.: 'On the Occurrence of Artifacts Beneath a Deposit of Clay.'

Dr. Charles Conrad Abbott, of Trenton, N. J.: 'On the Breeding Habits of the Spade Foot Toad (*Scaphiopus solitarius*).'

Professor L. H. Bailey, of Ithaca, N. Y.: 'Summary of the Recent Movements to Teach Agriculture in the Schools.'

Professor Carl Barus, of Providence, R. I.: 'Atmospheric Nucleation.'

Dr. Franz Boas, of New York: 'The Horizontal Plane of the Skull.'

Dr. Aristides Brezina, of Vienna: 'On the Collecting of Meteorites.'

Professor William Keith Brooks, of Baltimore: '*Doliolum* and *Scalpa*.'

Professor William W. Campbell, of Mt. Hamilton, Cal.: 'On the Spectra and General Nature of Temporary Stars' (with lantern slide illustrations).

Professor Edwin Grant Conklin, of Philadelphia: 'The Organization of the Germ Cells and Its Bearings on Evolution.'

Professor Charles L. Doolittle, of Philadelphia: 'The Reflex Zenith Tube.'

Mr. Eric Doolittle, of Philadelphia: 'Faint Double Stars.'

Dr. Charles B. Dudley, of Altoona, Pa.: 'A System of Passenger Car Ventilation.'

Professor John B. Hatcher, of Pittsburg, Pa.: 'An Attempt to Correlate the Marine with the Fresh and Brackish Water Mesozoic Formations of the Middle West.'

Professor Paul Haupt, of Baltimore: 'Biblical Pessimism.'

Professor Angelo Heilprin, of Philadelphia: 'Pompeii and Saint Pierre: an Examination of the Plinian Narration, and Other Studies' (with lantern slide illustrations).

Professor Waterman T. Hewett, of Ithaca, N. Y.: 'The Use of the Relative Pronouns in Standard English Writers.'

Waldemar Jochelson, of New York: 'The Yukaghis Language.'

Professor H. F. Keller, of Philadelphia: 'Dimethyl Racemic Acid, Its Synthesis and Derivatives.'

Professor Henry Kraemer, of Philadelphia: 'The Origin and Nature of Color in Plants.'

Professor Preston A. Lambert, of Bethlehem, Pa.: 'The Expansion of Algebraic Functions at Singular Points.'

Professor Marion D. Learned, of Philadelphia: 'Results of the American Ethnographical Survey.'

Professor LeRoy W. McCay, of Princeton: 'Trisulphoxyarsenic Acid.'

Professor John Marshall, of Philadelphia: 'The Constituents of the Venom of the Rattlesnake.'

Professor Otis T. Mason, of Washington: 'The Ripening of Thoughts in Common.'

Dr. Charles A. Oliver, of Philadelphia: 'Regulation of Color-Signals in Marine and Naval Service.'

Professor A. H. Phillips, of Princeton, N. J.: 'Radium from American Ores.'

Professor Albert B. Prescott, of Ann Arbor, Mich.: 'The Rôle of Carbon.'

Professor Theodore W. Richards, of Cambridge, Mass.: 'Sources of Error in the Determination of the Atomic Weight of Nitrogen.'

Professor Felix E. Schelling, of Philadelphia: 'The Pedigree of Elizabethan Drama.'

Professor William B. Scott, of Princeton, N. J.: 'The Miocene Rodentia of Patagonia.'

Professor Edgar F. Smith and Mr. F. F. Exner, of Philadelphia: 'The Atomic Weight of Tungsten.'

Mr. Gilbert van Ingen: 'The Silurian Fauna of Arkansas.'

Mr. Joseph Wharton, of Philadelphia: 'Palladium.'

### THE AMERICAN PHYSICAL SOCIETY.

The February meeting of the Physical Society was held in New York on February 27. For the first time since the famous address of Rowland in 1899 the society had the pleasure of listening to a presidential address, Professor Webster's subject being 'Some Practical Aspects of the Relations between Physics and Mathematics.' The address was delivered before a joint session of the Physical Society and the Mathematical Society. It will be published in full both in Science and with the 'Proceedings of the Physical Society' in the *Physical Review*.

Upon the recommendation of the council certain amendments to the by-laws were adopted whose purpose was twofold, viz.: (1) to

make possible the election of *associate members* as well as regular members; (2) to establish, for regular members, an entrance fee of three dollars.

The council was led to recommend such action because of its desire to extend the advantages of membership in the Physical Society to a larger number of persons, and at the same time to maintain a distinctly high scientific standard in the case of the regular membership. In the past the effort to accomplish both of these two aims has sometimes led to considerable embarrassment, both to the council and to members making nominations.

The policy of the council will hereafter be to elect to regular membership in the society only such persons as have contributed to the advance of physics by investigation of a serious character. Those who have been prevented from carrying out work of investigation, but who are otherwise desirable as members of the society, will be eligible for election to associate membership. Associate members will have all the privileges of membership except that they may not vote nor hold office. They will, for example, receive the two publications now furnished by the society to its members. Associate members may be transferred to regular membership by action of the council whenever they have completed research work of such character as to warrant such transfer. It is not the policy of the council to make election to associate membership a mere formality for any who may desire it. On the contrary, there is a strong feeling that the society would best accomplish its object in 'promoting the advance and diffusion of the knowledge of physics' by maintaining a high standard for both regular and associate membership.

The spring meeting of the society will be held in Washington, on Friday, April 22, and Saturday, April 23, 1904. Sessions for the presentation of papers will be held on Friday from 2 P.M. to 5 P.M., and on Saturday from 10 A.M. to 1 P.M. On Friday at 6 P.M. there will be an informal dinner, and later in the evening a lecture upon a subject to be announced later. On Saturday, at 1 P.M., a luncheon by the Philosophical Society of Washington, complimentary to the Physical Society. Saturday afternoon an excursion to the Bureau of Standards and the Weather Bureau. The arrangement of further details regarding the meeting is in the hands of a committee of the Philosophical Society of Washington, at whose invitation the meeting is held in that city.

Brief abstracts of the papers read at the February meeting are given below.

*The Conduction of Electricity in Mercury Vapor:* A. P. WILLS.

This paper gave the results of an extended study of the mercury vapor lamp carried out in the Hewitt laboratory during the past year. The measurements had especial reference to the electromotive intensity in the positive column. It was found possible to develop an empirical formula representing with great accuracy the dependence of the potential gradient upon current, pressure and diameter of tube. The drop at the anode, usually about seven volts, was found to rise under abnormal conditions as high as fifteen volts. The drop at the kathode was about five volts.

*Experiments Showing the Action of a Magnet upon the Mercury Arc:* PETER COOPER HEWITT.

Several very interesting experiments with a large mercury vapor lamp were shown by Dr. Hewitt. The action of a magnet upon the positive column seemed to be about the same as in an ordinary vacuum tube. The effect upon the brilliant spot of light, or flame, at the kathode was especially interesting. When the lamp was in a rather strong field a luminous bundle of rays was seen to proceed from the bright spot on the kathode surface, following a path that was the same as that of the lines of force of the field.

*Microphotography of Fog Particles and the Photographic Study of Atmospheric Nucleation:* CARL BARUS.

The author gave a description of his apparatus and methods, and illustrated the results by a series of ten lantern slides and many positives showing the microphotographs of fog particles. Most of these were strikingly distinct, the water globules ranging in size from

about .0002 cm. to .002 cm., according as fogs of different degrees of fineness were precipitated. The most highly graded nuclei, as shown by the presence of fog particles of all sizes, were obtained from an exposure of dust-free air to the X-rays for from one to ten minutes, depending on the intensity of radiation. Much greater uniformity is shown in the cases of phosphorus and ordinary air nuclei.

The author described a number of curious phenomena observed with these water particles, among which their continued motion when caught on a film of liquid oil, simultaneously to and fro between edges of the film, is most noteworthy. Particles moving in swarms in opposed directions are often in the focus of the microscope together, and thus lie very nearly in the same plane. The author finally remarked that the coronal method had now been so far perfected that the nucleation increment produced by a single gas flame in a moderately large lecture room could be detected in about ten minutes, even in the air collected from near the floor. This favorable quantitative result may then be supplemented qualitatively by the photographic method, which will show the presence of exceptionally small or large particles, whose effect vanishes from the corona as they are relatively few in number.

*Preliminary Measurements of the Short Wave-lengths Discovered by Schumann:* Theodore Lyman.

The measurements were made with a concave grating ruled on speculum metal, which was found to reflect the extremely short waves used in considerable intensity. All work was carried on in an atmosphere of hydrogen and at low pressures. Numerous lines were found in the spectrum of hydrogen lying well beyond the aluminum group at 1,854. The shortest wave-length thus far measured by Dr. Lyman was 1,206 Angström units. This lies far beyond the region where wave-lengths have previously been *measured.* Dr. Lyman is certainly to be congratulated upon the success of these distinctly difficult measurements. The present communication is merely preliminary.

*The Hall Effect in the Electric Arc:* C. D. Child.

If two carbon pencils are so placed in an arc that there is little or no potential difference between them, a potential difference is produced by creating a magnetic field about the arc. This may be as high as 1.5 volts. It appears to be similar to the Hall effect in metals, and if it is this effect, it would show that the negative ions have a velocity enormously greater than that of the positive.

Salts placed in the arc which diminish the drop of potential at the anode also diminish the effect here studied. With $KNO_3$ the anode drop becomes as small as that at the cathode and the potential difference between the two pencils became approximately zero. When the pressure is reduced to about 1 cm. the effect also disappears.

No definite explanation of the phenomenon can at present be given. It appears, however, to be a more complicated effect than the ordinary Hall effect in metals.

*Some Further Observations on the Radiation Produced in an Alternating Condenser Field:* Fernando Sanford.

The author has continued the experiments described in the December number of the *Physical Review,* where it was found that certain photographically active rays are given off by a plate connected to the *negative* pole of an induction coil, even when no visible discharge occurs. It has now been found possible to measure the wave-length of these rays by means of a grating. Values are found ranging from $350\mu\mu$ to $377\mu\mu$, depending upon the metal of the kathode. The rays, therefore, lie in the ultra-violet just beyond the edge of the visible spectrum.

Ernest Merritt,
*Secretary.*

## THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 151st meeting was held on February 10, 1904.

A topographic model of Alaska made by Mr. Edwin E. Howell was exhibited and was briefly described by Mr. Alfred H. Brooks.

This model of Alaska, which is to form a part of the Geological Survey exhibit at the

Louisiana Purchase Exhibition, is based, for the most part, upon the topographic surveys made during the past six years by the Geological Survey parties. The coast line is taken from the charts of the Coast and Geodetic Survey. The base map, which was also exhibited, was compiled by Mr. E. C. Barnard, under the direction of the late Mr. R. U. Goode, and the scale of both the model and the map is forty miles to the inch. In the model the vertical scale has been exaggerated five times, while on the map the contour interval is 1,000 feet. This map represents the first attempt to show the relief of Alaska by contours. While much of it will be subject to revision by future surveys, it is believed that in its present form it is of a sufficient degree of accuracy to be worthy of publication and that it correctly represents the larger geographic features of the territory.

The coloring of the model is intended to indicate, in a broad way, the distribution of timber, as well as that of the ice and snow. Many will be surprised to find what a small part of Alaska is covered with perpetual snow and that the glaciers are practically confined to the coastal mountains of Alaska. It will be noted that the heavy timber is limited to the Pacific coastal belt of Alaska, east of Kodiak Island, and to the immediate vicinity of the larger rivers of the Yukon Basin. Above the timber line, which in southeastern Alaska is between 3,000 and 4,000 feet, and in the northern part of the territory descends to about 1,000 or 1,200 feet, are broad areas which are entirely devoid of forests. The attempt has been made on the model to represent this treeless region by colors suggestive, at least, of vegetation.

Besides this high timberless belt there are other large areas of regions of relatively low relief, which are also devoid of timber. These are the coastal plains, which stretch from the Alaskan Peninsula northerly to the Arctic, and thence sweeping around to the north of the Rocky Mountains, extend eastward to the McKenzie. This so-called *tundra* is a part of the great zone which encircles the polar regions. It is devoid of timber except for the dense growth of willow which is found along many of the sheltered stream valleys.

Alaska includes an area of about 570,000 square miles, about one fifth of the area of the United States, and two thirds of the region included in the Louisiana Purchase. The shape is irregular and consists of a large compact body of land, with projections to the southeast and southwest, the former called the Panhandle, or southeastern Alaska, and the latter the Alaskan Peninsula. The peninsula is extended to the westward by the Aleutian Chain, to where it is met by the Commander Islands, a somewhat similar easterly extension from the Peninsula of Kamchatka.

The Pacific and southern Bering Sea coast of Alaska exhibits unusual irregularity of form, including many islands and many fiords which penetrate the mainland. The arctic and northern Bering Sea coast line is much more regular, and is characterized by shoal water conditions and straight shore lines. The relief of Alaska exhibits a wealth of contrasting variety in mountains and valleys, plateaus and lowlands, which are developed on a truly grand scale. Broadly speaking, the larger features of topography correspond with those of the western United States. There is a Pacific Mountain system separated from the Rocky Mountain system to the north by a Plateau Region, and north of the Rockies lies a plains region, forming the Arctic Slope Province.

The Pacific Mountain system includes four ranges, the Coast, the St. Elias, the Aleutian and the Alaskan. The highest points in northwestern America and also on the continent lie within these ranges, and are Mount St. Elias, 18,080; Mount Logan (Canada), 19,500, both in the St. Elias Range; and Mount Foraker, 17,000, and Mount McKinley, 20,300, the two latter in the Alaskan Ranges.

Less is known of the Rocky Mountain system, which extends through the Yukon territory, and upon approaching the Arctic coast bends westward. To the west it is divided into two ranges separated by the valley of the Kobuk River. Between the two mountain systems lies the province which has been called the Plateau Region. This is char-

acterized by broad, flat-topped inter-stream areas, whose summits mark a well-defined plain. The Arctic Slope Region includes a small area lying north of the Rocky Mountains.

The model shows not only the relief, but also the distribution of the timber and the mineral deposits, as far as they have been determined. It will be noted that the gold placers have a very wide distribution through Alaska, that copper has been found only in the Pacific Mountain belt, tin at the western end of the Seward Peninsula, while coal has been found in many widely separated localities. The lode mines which have been developed up to the present day are practically all confined to the Pacific Coastal belt.

Mr. George B. Shattuck then presented a paper on 'Recent Elevations and Depressions in the Bahama Islands,' illustrated by stereopticon. This paper was based on the results of the expedition sent out by the Geographical Society of Baltimore, and will soon be published in full.

A third paper, by Mr. G. K. Gilbert, had for its subject, 'Domes and Dome Structures in the Sierra Nevada,' and is now in print as a bulletin of the Geological Society of America.

ALFRED H. BROOKS,
*Secretary.*

BIOLOGICAL SOCIETY OF WASHINGTON.

THE 383d regular meeting of the society was held on Saturday evening, March 5, 1904. Dr. A. K. Fisher delivered an illustrated lecture on the 'Birds of Laysan Island,' based on observations made by W. K. Fisher, of Stanford University, during the summer of 1902, while connected with the U. S. Fish Commission steamer *Albatross*. Laysan Island, which lies in the Pacific, about 800 miles northwest of Honolulu, is one of the most remarkable bird islands in the world. It is the home of countless thousands of sea birds, such as albatrosses, terns, gannets, frigates, shearwaters, petrels, etc., and has rarely been visited by naturalists. A most detailed account of the bird population of the island was given. The photographs shown constitute one of the most interesting series of bird pictures ever taken.*

Mr. J. N. Rose exhibited some fifty watercolor drawings to illustrate the genera of Crassulaceæ recently segregated by Dr. N. L. Britton and himself. The drawings are the work of Mr. F. A. Walpole and have been executed with great skill. Mr. Rose pointed out the fact that the number of genera in Crassulaceæ as compared with the number of species is very small, and that nearly all the species of the world are to be found in six genera. He states that complaint is often made that the generic limits are very indistinct which he thinks can be remedied by increasing the number of genera. He finds that *Cotyledon,* a South African genus, is to be excluded from American groups, and that, in place of it, *Echeveria* is to be restored. To the latter most of the Mexican species are referred. A new genus, *Dudleya,* is proposed for certain species from the west coast of North America.

WILFRED H. OSGOOD,
*Secretary.*

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 581st meeting was held February 27, 1904. The evening was devoted to aeronautical subjects.

Dr. A. F. Zahm read a paper on 'Atmospheric Friction with Special Reference to Aeronautics,' giving a partial account of one of the researches on air resistance which he has been conducting the past three years, at the Catholic University of America. His measurements show that the skin friction $R$, of a thin material plane of length $l$, and speed $v$ moving through still air, is expressed by an equation of the form $R = al^m v^n$, in which $a$, $m$, $n$ are numerical constants for all speeds up to the limit of experiment, which was about 25 miles an hour. For a strip of the plane one foot wide and $l$ feet long moving $v$ miles an hour, the above formula gives $R = 0.0000336 l^{0.93} v^{1.85}$,—$R$ being in pounds. Applying this equation to practical problems he showed that the element of skin friction is

* An illustrated account of the birds of Laysan has been published by W. K. Fisher, Bull. U. S. Fish Comm. for 1903, pp. 1–39, pls. 1–10.

as formidable an obstacle in aeronautics as in marine navigation, where it is one of the chief resistances. To overcome the friction on the surface necessary to support 100 pounds under practical conditions of flight requires about one horse power on a tow line, or nearly two horse power applied by propellers.

Mr. Charles M. Manly, of the Smithsonian Institution, presented the 'History and Present Status of Aeronautics.' He traced briefly the development of balloons for a century till Renard and Krebs in 1884 made a flight of two and one half miles, returning to their starting point; and he gave the data of the machines and flights of Santos Dumont, von Zepplin, Le Baudy brothers and others. The highest speed reported is twenty-three miles per hour.

The development of aeroplanes was traced in more detail. Models heavier than the air were flown in 1842 and 1878. In 1868 Stringfellow built a model with steam-engine and boiler carried by the superposed planes suggested by Wenham in 1866, though this never flew. In 1891 Professor Langley, and about the same time Maxim in England, published the results of systematic experiments on the principles underlying the subject. Some years later successful flights were made by machines with motors of over one horse power. In 1903 Mr. Langley's aerodrome, with a 52 horse-power gasoline-engine weighing with cooling water and all accessories only 200 pounds, and carrying one passenger, was launched. Accidents to the launching devices prevented a successful flight; but the speaker had no doubt of the ability of the machine to fly. Reference was made to the reported success of the Wright Bros. in North Carolina, but full data are not yet available; to the remarkable invention of Mr. A. G. Bell whose tetrahedral kites promise to furnish supporting planes, the weight of which increases little faster than the area; and to the experiments of Lilienthal and others with gliding machines.

In the discussion that followed Professor Langley emphasized the value of Dr. Zahm's measurements, of Mr. Manly's work in reducing the weight of the motor, and of Mr. Bell's novel supporting planes. Professor Bell told of the curious history of the idea of air *ships*, and said Mr. Manly was the first to risk himself on a power-driven aeroplane. Others spoke of recent English theoretical work, and of the attitude of the U. S. Patent Office which, though granting nearly 300 patents for structures involving a gas bag, has held that aeroplane devices, not having been shown to be operative, are not entitled to protection by a patent.

CHARLES K. WEAD,
*Secretary.*

THE NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE fiftieth regular meeting of the section was held in Huntington Hall, Massachusetts Institute of Technology, Boston, Thursday evening, February 25, with President W. H. Walker in the chair. About 900 members and guests were present.

Mr. E. Stütz, vice-president of the Goldschmidt Thermit Co., gave an address on 'Aluminothermics, and their Applications to Engineering and Metallurgy.' Mr. Stütz described the various uses of thermit, the trade name given to a mixture of powdered aluminum and the oxides of various metals, in which when ignited a reaction is brought about, whereby a great amount of heat is generated, oxide of aluminum is formed, and the metal set free from its oxide is obtained in a molten condition. Large masses of pure chromium, manganese and other metals were shown, and a demonstration of the preparation of pure nickel from the oxide was made. The principal use of thermit at present is in the formation of iron from a mixture of powdered aluminum and oxide of iron, and the application of this to various forms of welding. Mr. Stütz demonstrated the method by burning a hole through a plate of wrought iron three fourths inch thick, by allowing a stream of molten iron as formed by the reaction to fall on the plate, also by welding a nine-inch girder rail, by welding iron to casting to illustrate a method of repairing flaws, by welding iron pipe, and other experiments.

A number of lantern slides were also shown,

illustrating the practical methods of using thermit in welding electric car rails in place, repairing broken stern posts and shafts in large steamers, etc.

Arthur M. Comey,
*Secretary.*

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## *DISCUSSION AND CORRESPONDENCE.*

### CONVOCATION WEEK.

In the multitude of counselors there is said to be safety, and it may be hoped that a sound conclusion may be evolved from the widely differing views which are finding expression in the columns of Science.

In my own opinion, as in the opinion of some others who have already written, it has been a mistake to change the time of the meeting of the American Association from summer to winter. The American Association is and should be a popular association. It seeks to include in its membership not alone professional workers in science, but the wider public who have a more or less intelligent interest in the results of science. It appeals not only to the professors in the universities and colleges, but also to the great army of teachers in the secondary schools. It draws its members not from one district, but from all parts of the continent. Now I think that the time for the meeting of such an association is the summer vacation. In our winter, long journeys are apt to be more or less uncomfortable, and trains are not infrequently seriously delayed by snow. It is impracticable for the colleges and schools to arrange their work so as to allow a long vacation at Christmas time; and part of the Christmas vacation is and ought to be devoted by most of the students of science in the country to the claims of home and family. Both the inclemency of the weather and the shortness of the time at our disposal render it impossible to have excursions in connection with a Christmas meeting; and, in the American Association, as in its illustrious prototype, the British Association, the excursions are a very valuable part of the privileges offered by the meeting. Any one who has attended a meeting of the British Association in recent years, studied the elaborate guide-book for the locality prepared by the local committee, and availed himself of the opportunities of excursions adapted to his own tastes and studies, whether he be a geologist or a naturalist or an archeologist or an engineer, will appreciate how valuable this part of the work of such an association may be made. These excursions are valuable alike to the professional scientist and to the amateur.

While the Christmas vacation seems to me a very unsuitable time for the meetings of the American Association, it is an excellent time for the meetings of the numerous associations of more restricted membership and more definite scope. In several cases these narrow professional societies have already divided themselves into sections distributed in different regions of the country. The members of a local section of such a society can easily get together in the Christmas vacation. The journeys required are comparatively short, and the time at their disposal is amply sufficient. Their program does not aim to cover all science; they are not required to do anything in the way of popularization; they can meet for a few days of quiet, earnest work in the discussion of the papers of a homogeneous program; they can find relief from the serious work of the sessions in a dinner or a smoker or both; and, when they have done their scientific work, and enjoyed their friendly greetings and renewal of cherished associations, they can go home in season for the opening of the winter term in the institutions with which they are connected.

It was said by many that the large attendance and the great interest in the Washington meeting were the vindication of the plan of a winter session of the American Association. It must be remembered, however, that Washington is altogether an exceptional city. In the number of resident scientific men, and in the variety of museums and other indoor attractions for students of science, professional or amateur, Washington stands unrivaled. The success of the Washington meeting was due to the exceptional character of the locality. The comparative failure of the St. Louis meeting affords more nearly a just criterion of the expediency of the plan.

I believe, therefore, that the right plan is to put back the meeting of the American Association to its old place near the close of the summer vacation, and to leave convocation week for the smaller, more homogeneous, and less popular associations of working scientists. WILLIAM NORTH RICE.

### NATURAL SELECTION IN KINETIC EVOLUTION.*

THAT there are species, varieties, mutations or hybrids which differ in one, two, or three characters, as commonly assumed in discussions of Mendel's laws, is a misleading assumption. To speak of a species as having developed in one direction or as having a single peculiar character may be permissible for taxonomic purposes, but in evolutionary studies it is careless to forget that the diversity is general, if not complete. The diversity of varieties and species is like that of individuals, but greater. Evolution, which is a continuous summary or integration of this individual diversity, is not a simple process, but highly multiplex; as much so, indeed, as the lines of descent in which the life of the species goes forward. A composite general direction is maintained by the species because the multitudinous strands of individual descent are bound together by interbreeding. The variations take place in particular threads, but evolution signifies rather the progressive change of the whole organic network.†

The evolution of a new type means changes in many directions and of many kinds, in the germ cells and in the various tissues and organs, as well as in the external form of the complex cell-colony which we are accustomed to look upon as a single individual. Each cell, tissue, organ and feature is undergoing evolution, and for normal and permanent progress these manifold developments must keep together. When single lines or slender strands of descent are separated from the main network the congruence of type is lost. The normal variation and individual diversity of the species having been eliminated, the evolutionary coordination of cells, organs and functions breaks down, and abrupt changes or aberrations of heredity appear. These degenerative mutations may not differ in their essential nature from normal variations, but the conditions of their appearance are abnormal, and the results often disastrous.*

A domestic variety may be 'improved' by the further increase of the one or two characters or qualities which render it valuable, but a new specific or generic type is the compound or resultant of many variations in many characters. By close selection which restricts evolutionary progress to a narrow line of descent a 'single character' may push out farther in a decade than the natural multiplex evolution would carry it in a century or a millennium, but such a specialization weakens and unbalances the organism, and is a process of degeneration rather than a constructive evolution. Selective inbreeding and other forms of isolation accentuate single characters, but the interbreeding of normally diverse individuals (symbasis) weaves new types out of the variations of many lines of descent.

The neglect of this distinction vitiates much evolutionary literature, both that which treats selection as an actuating 'force,' and that which rejects selection for 'discontinuous variation' or 'the mutation theory.'† It is

* Read before the Biological Society of Washington, March 19, 1904.

† *The Popular Science Monthly*, March, 1904, p. 451.

* Mutations, like hybrids, are sometimes completely sterile, and they may have at the same time an increased vegetative vigor. The vegetative vigor of many mutative varieties of domesticated plants has doubtless delayed the recognition of their abnormal evolutionary status, though the abnormality of infertile hybrids has long been appreciated. It is paradoxical, indeed, that the increased vigor which accompanies normal variations and crosses should also attend degenerative changes, but there is room for this apparent contradiction in so complex and many-sided a process as evolution.

† Very recent examples of the latter tendency are found in Professor Morgan's 'Evolution and Adaptation' and also in Dr. D. T. MacDougal's review of this work (*Torreya*, 3: 185, December, 1903). Professor Morgan refers (p. 368) with approval to an admission by Darwin that selection can not explain dimorphism in plants be-

true that many variations of inbred domesticated plants and animals are very abruptly discontinuous, and that such changes are not caused by selection,* but these facts in no way militate against others equally obvious, that the natural evolution of new types is a relatively slow and gradual process, and that selection may easily influence the direction of this continuous vital motion. The older selective hypothesis was only half erroneous. Selection does not set stationary organisms in motion, but it often guides spontaneous change. It does not explain evolution or vital motion in general, but it does explain adaptation, or motion in some particular direction, as when one species differs from its relatives in special characters which enable it to exist in a special environment. That all adaptations are mere coincidences is as improbable as that all characters represent useful adaptations.

Selection is not, as many 'Darwinians' have maintained, the true, efficient cause of evolution; the vital motion of species proceeds whether selection is operative or not. Species do not acquire characters from the environment, but merely in accordance with it. At any point in the evolutionary journey, selection may determine whether certain characters shall be acquired or not; it is an obstacle in the environmental road over which the species would travel, instead of being the source of power of the organic automobile. By preventing motion in one direction selection may be said, of course, to cause advance in another, but it is apparent that this causality is negative and passive, or a mere figure of speech. Selection may explain why a particular character is accentuated in a particular species, but it is no more a cause of the developmental progress of the species than the turns of the road are the motive power of the vehicle. Segregation enables species to attain differential characters, and selection assists their accommodation to environment, but both these possibilities rest on the more fundamental fact that organic evolution goes forward without external causation in groups of diverse, interbreeding individuals. If a species stood still selection could effect nothing except its partial extinction. In the recognition of a continuous and universal evolutionary motion the kinetic theory supplies the long-sought explanation of selective influence. By ceasing to look upon selection as a mysterious evolutionary cause we are able to ascribe to it a practical and easily comprehensible evolutionary function.

O. F. Cook.

Washington, D. C.,
March 11, 1904.

cause it can not be an advantage to a plant to be able to breed with only half of the members of its species. The same reasoning would apply, however, to all the phenomena of sexual separation, of which the dimorphism of bisexual plants may be an incipient stage. It seems obvious, too, that to breed successfully with half of the individuals of a species is an important advantage over the alternative of breeding less effectively with all of them. The partial or complete sterility of some dimorphic plants to the pollen of others of their own caste may be due to impotency rather than to adaptation, and a dimorphism by which this fatal result could be avoided would certainly be favored by selection.

* Except as selection implies inbreeding, by which mutations are induced.

### NATURE STUDY.

To the Editor of Science: In the last two numbers of Science have appeared articles by Drs. Wheeler and Chapman on the abuses of nature writing as exemplified in the writings of Wm. J. Long. These articles have expressed the fear that such work may increase and that it may invade the secondary schools as supplementary reading designed to aid in the instruction in zoology. That this is no idle fear is brought very vividly before the science teacher in the normal schools, for he stands, as it were, an outpost between science and its teaching to immature students. Permit me to call your attention to a pseudo-scientific extravaganza put forth in a seeming serious mood which exemplifies this point. Before me is a book designed evidently for students of the first grades called 'The Tree Dwellers.' It bears the publishers' imprint of Rand, McNally and Co., 1903, and its author is Katherine E. Dopp, of the Extension Division of the Chicago University. The attempt of the book is to place before the stu-

dent an account of primitive child life. The author states in her preface that she was aided in the preparation of her material by the late Professor J. W. Powell, by Fred. J. V. Skiff, of the Field Columbian Museum, and by Professor Dewey, of the Chicago University; other less prominent names are mentioned as collaborators.

Perhaps the most glaring errors that the author has included in her work are certain of the pictures; these are signed by Howard V. Brown.

On page 67 is a sketch of a dinosaur, evidently intended for the *Ceratosaurus* of Marsh, an Upper Jurassic form, chasing a beast that is described as a 'five-toed horse'; accompanying this figure is the following text:

> Long, long before the tree-dwellers lived there were wild horses.
>
> They were tiny little creatures.
>
> Perhaps you would not think that they were horses at all.
>
> They were no larger than a fox.
>
> They had stripes like a zebra.
>
> They had five toes on each foot.
>
> They lived on the marshes and on the dry land.
>
> The land at that time was almost covered with water.
>
> The water was filled with fish and reptiles.
>
> Great reptiles crawled about everywhere.
>
> They were masters of the sea and the dry land.
>
> All the creatures feared them, the wild horses tried to keep out of their reach.
>
> The foot of the little horse was not shaped for running, but it was fitted for climbing trees.
>
> When a reptile appeared the *horses climbed the trees.* (Italics mine.)
>
> They stayed in the trees till the danger was passed.
>
> Then they came down to their pastures again.

Again, on page 62 I find a picture of a man in a tree watching a herd of the same horses (?) that were pursued by the Jurassic dinosaur! This makes man contemporaneous with the dinosaur, although it is not so stated in the text.

This book is filled with just such mistakes throughout, notably a figure of a saber-tooth tiger in fierce combat with a hairy mammoth.

That such a book is taken seriously by certain people is shown by the fact that it has been placed in the library of at least one normal school as supplementary reading for students in the kindergarten course, girls who are preparing themselves to teach nature study to infants.

Certainly if such things as anthropology and vertebrate paleontology are to be forced on the four-year-old child the perpetrators should see that it is correct.

We are promised four other volumes by the same author from the same press! Certainly it is time to call a halt.

E. C. Case.

State Normal School,
Milwaukee, Wis.

## SPECIAL ARTICLES.

### AN ACCOUNT OF SOME EXPERIMENTS IN REARING WILD FINCHES BY FOSTER-PARENT BIRDS.

During the spring of 1901, having some twenty pairs of canary birds mated, I attempted to induce them, in two cases, to incubate the eggs and rear the young of wild fringilline birds. These experiments led me to continue similar efforts during each succeeding spring, and I propose to summarize the results of what occurred in this way, in 1901, 1902 and 1903.

In May, 1901, I secured a set of song sparrow's eggs (*Melospiza cinerea melodia*). There were four eggs in the nest and incubation had just started. I brought the eggs, together with the nest, to my laboratory, and took away from a very tame hen canary bird four eggs which were in her nest, substituting the song sparrow's eggs. I watched the hen canary for a short time to assure myself that my actions had not prejudiced the end I had in view, and was presently delighted to see her return to the nest and settle herself to brood the eggs as if they were her own. In due time, after about eight days, all of the eggs were hatched, and four lusty young song sparrows became the foster-children of the canary. This bird was an especially good parent, as I had proved, by her rearing with success three broods of canary birds during the preceding season of 1901, the whole of the young aggregating thirteen birds, all of which reached maturity, and were strong vigorous examples of their kind. This hen canary

seemed as solicitous for the young song sparrows as she had been for the young of her own kind, and so far as I could see, she did everything in her power to rear her foster-children. In spite of all her efforts, when the song sparrows attained an age of about six days, and were just beginning to show feathers, one by one they weakened and died, though both the parent canaries, cock and hen, fed and brooded them constantly.

Later in the same season I secured a clutch of four field sparrow's eggs (*Sipizella pusilla*), and gave them to another equally good pair of parent canaries. The results were almost identical with the case cited above; the eggs were all hatched, the young seemed strong and vigorous, the foster-parents appeared to do everything conducive to their development, but all of the young died during the first week after they were hatched from the egg. This concluded my efforts in this direction for the spring of 1901. In the month of May, 1902, I was able to carry on a much more elaborate series of experiments, which I will now summarize. Some of these, in the light of my former experience, I conducted under slightly varying conditions, which I thought might yield more definite results. On May 11, 1902, I found in a field on the ground a nest of field sparrows, the female sitting on four eggs, and there were, at the same time, two larger eggs in the nest, which I took to be those of the cowbird (*Molothrus ater*). The nest and eggs I brought to the house, keeping them warm, and placed the four field sparrow's eggs under a hen canary which was sitting, and the two cowbird's eggs I gave to another canary. Both females covered the new eggs which had been introduced into their nest, and brooded them within a moment after I had left them. The four field sparrow's eggs, placed under the first canary, began to hatch on the morning of May 22. I had left one canary bird's egg in this nest, and this also was hatched early the next day. Another of the field sparrow's eggs hatched late on May 22, and in the morning of May 23 there were in the nest one canary and three field sparrows, and one unhatched egg of a field sparrow. On May 24 I discovered the three field sparrows dead in the nest, but the young canary bird was flourishing, and in the course of time grew up to maturity under its parents' care.

To return to the cowbird's eggs in the same clutch; both of these eggs were hatched on the morning of the twenty-second, and, also, two canary bird's eggs which I had left with them, so that there were two cowbirds and two young canary birds in the nest. Throughout the day and on the succeeding one the parent birds paid close attention to the brood, and the young birds, I could see, were strong and hearty, as all four of them raised their heads to be fed, and seemed to be treated precisely alike by the two parent canaries. The same conditions prevailed on May 24. On the morning of May 25 the birds were doing well and had grown rapidly. On the afternoon of May 25 one of the cowbirds died, though the other was still strong, and with the two young canary birds was constantly fed by the parents. On May 25 the second cowbird died, and I introduced two young chipping sparrows, apparently of about the same age as the two young canaries, to take the place of the two cowbirds. I saw the old canary bird at once feed the two sparrows as she did her own birds, and during the day a young man, whom I had posted to watch the proceedings, reported that they were constantly fed. On May 27 the two young sparrows were strong and healthy, as well as the young canaries. The same conditions prevailed on the twenty-eighth, and on the twenty-ninth of the month. On May 30 one of the sparrows died and was removed. the other appeared strong and healthy, and so far fledged that its species could be discriminated. The old birds fed the remaining young one throughout the day as well as the young canaries. On May 31 the young sparrow and the canaries were vigorous and flourishing. This condition of affairs was maintained until June 2. On June 2 I found the single sparrow so far grown as to be able to leave the nest, though the two canaries were not so far advanced. At eleven o'clock the young sparrow left the nest and hopped about the floor of the cage; after an hour I put him back in the nest, where he remained till the

next morning. On June 3 the chipping sparrow again left the nest, and I did not return him to the structure until late in the day. On the fourth, the two young canaries and the chipping sparrow all left the nest, though the canaries resorted to it from time to time. All the birds grew and flourished, but on the ninth of June the chipping sparrow died. The two canary birds, however, throve and ultimately reached maturity. During the latter part of his life the sparrow was going about the bottom of the cage and hopping on the perches, attended to carefully by the parent birds. He, however, did not seem especially strong in his legs, and for a short period, four or five hours before his death, he was not only unable to grasp the perches, but could not run about the bottom of the cage as he had done earlier. I concluded that several factors may have militated against the rearing of this bird by the canaries: (1) His development seemed more rapid than that of the young canaries, and he was more restless and anxious to leave the nest than were the domesticated birds. (2) I think that the artificial lining of the canary's nest was of such a nature as not to permit the proper development of the leg muscles and feet during the time he was in the nest. (3) The length of the tarsus in the sparrow, being twice as great as that of the canary birds, seems an important element to take into account, as this part of the leg was so long that it seemed to be not only in his way, but was constantly trodden on and sat upon by his two associates. It must be remembered that this bird left the nest voluntarily on the date first mentioned, and though restored several times, very soon left it again. He appeared to be very uncomfortable in the nest, and this discomfort was largely due to the length of his legs. At the time of his death the bird was about two thirds grown, and almost fully feathered in the first plumage of the chipping sparrow (*Spizella socialis*); though he could hop about the floor of the cage, and for a time was able even to balance himself on the perches, his legs, on the whole, seemed weak, and I attribute the cause of this misdevelopment of the muscles and tendons of the feet and legs to the kind of nest lining used by the canaries. I may say here that this consisted of deer-hair with an admixture of cow-hair, the whole being a felted mass, and not presenting the grasping surface afforded by the fabric and lining of the chipping sparrow's nest, as found out of doors.

My experiments in the season of 1902 included, besides the above, an additional brood of song sparrows, which contained four song sparrow's and one cowbird's egg. All of these hatched and lived from periods varying from four to seven days, none of the birds leaving the nest. I also experimented with a clutch of five fresh eggs of the yellow-winged sparrow (*Ammodramus savannarum passerinus*), which I divided between two different parent canaries, leaving two canary's eggs with three yellow-winged sparrow's eggs, and in the other case two yellow-winged sparrow's eggs with three canary bird's eggs. Both clutches were hatched, there being five young birds in each nest. The canary birds in both cases were reared and reached maturity, but the young yellow-winged sparrows which were also hatched died at ages varying from four to seven days.

I also attempted during this season to raise young bobolinks under canaries (*Dolichonyx oryzivorus*); to this end on May 28, having found a nest of five eggs, I introduced two of them to a large breed of English canary, leaving two of her own eggs in the nest; the other three bobolink's eggs I placed under another canary of a similar kind, leaving two canary eggs in addition. This canary threw out her own eggs, but retained the bobolink's eggs, and incubated them till they were hatched, which was on June 8. The three young bobolinks lived for three days, when one of them died; the remaining ones died on the fifth day. The other bobolink's eggs, under the English canary, were also hatched on the eighth, but both died on the tenth of the month; the young canary birds hatched at the same time were reared to maturity, when I no longer followed their history.

In the spring of 1903 I tried several similar experiments, sometimes putting but one egg of a wild bird with a clutch of canary's eggs,

and never giving one canary an entire complement of wild bird's eggs. In all cases the eggs were hatched and in no case did the foster-young attain an age of more than a week, though it is to be remembered that in every case young canaries in the same brood with the foster-birds flourished and reached maturity. During the season of 1903 I took two young song sparrows, just beginning to show the feathers, and put them with two canaries about the same size, though more fully feathered. These birds were readily adopted by the parent canaries, but one of them died after three days; the other was reared, reached maturity, was weaned by the old birds, being treated precisely as were their own young, and is still alive at this writing.

This series of experiments I have reported as a suggestion for further work of a similar kind. I had hoped that hatching the eggs of wild birds under canaries would enable me to observe the development of the foster-young to an advanced age. It seemed to me that there would be no possibility of their song being other than such as could be attributed either to inheritance or to intimate association with a new kind of singing bird. In all this I have, of course, met with disappointment; the only young bird being reared to maturity, from the many I have tried, was a song sparrow, almost fledged before introduced to his foster-parents. It has occurred to me that perhaps the kind of food, partially digested by the parent canary birds, and then regurgitated and fed to their young, would have militated against the growth and development of another kind of bird. However, in the case of three cowbird's eggs upon which I have experimented, all of which were hatched, this should not have prejudiced their growth, when we consider the variety of foster-parents that are induced to hatch and rear the eggs and young of the cowbird.

To briefly summarize the work I have described in some detail, forty-one different eggs of wild birds, representing six species, and three young birds already hatched, form the aggregate of individuals dealt with. All of the forty-one eggs were fertile, and were hatched by the foster-parents. This is suggestive in regard to the propagating powers of wild birds, and though not conclusive, indicates a much higher percentage of fertility in the eggs laid by them than obtains in song birds when caged, or semi-domesticated. None of the young which were hatched from these eggs reached a greater age than seven days, which would seem to indicate that the food supplied by the foster-parents, which was the same on which they raised their own offspring, was of a kind so different from that used by wild birds in rearing their young, that it proved inadequate. I also believe that the nest lining was of a character so unlike that of the nests natural to the foster-chicks, that it prejudiced their development and growth.

In the light of the knowledge I have gained I shall endeavor, in the coming breeding season, to conduct further experiments of a similar character, and hope for better results. It seems worthy of note that I have been able to rear not only all the kinds of birds mentioned by hand, but in addition some twenty other species of song birds. These birds have been taken from their parents' care at ages varying from three to six or seven days, and over ninety per cent. have been successfully reared, being fed by hand. Such birds in most cases have not only reached maturity, but many of them have lived from three to seven years.

William E. D. Scott.
Department of Ornithology,
Princeton University.

### NOTES ON POLYODON, I.

While engaged last summer on the upper Mississippi in investigating the natural history of the spoonbill (*Polyodon spathula*) I had occasion to examine a great many specimens, caught by the fishermen in a five-hundred-yard seine. My attention was soon called to the presence of a pair of minute barbels some distance in front of the mouth. Not recalling any reference to these in the literature on *Polyodon,* I examined a great many specimens and invariably found them present. A further examination of the literature shows that among systematists these barbels have been entirely overlooked, although the ordinarily recognized affinities of the fish to the

sturgeons would cause one to look for them especially. So Jordan and Evermann (Bulletin 47, U. S. N. M., Pt. 1, p. 101), in their characterization of the Polyodontidæ, say definitely, 'no barbels.' Only within the last few weeks I have discovered what is seemingly the only reference to these barbels, in a paper by Mr. Edwards Phelps Allis, Jr. (*Zoologische Jahrbücher*, Abth. für Anatomie, etc., Vol. 17, p. 671).

In a specimen of *Polyodon* 85 cm. long, these barbels lie 47 mm. in front of the mouth, on the ventral surface of the 'paddle.' They are 23 mm. apart, and the right one measures 3.5 mm. in length. The left one is considerably shorter, and in general there is considerable difference in their size in different individuals. They are very slender, nearly colorless, and translucent. It seems doubtful whether they are functional.

The fact that these barbels have not heretofore been noticed even by our best systematists suggests the idea that they may not be present in specimens from other regions. As to this point I hope to gather evidence next summer, in connection with other researches on *Polyodon*.

Another interesting point concerning *Polyodon* is the occurrence of peculiar small true scales over the surface lying over the entire scapular arch and extending forward the entire length of the isthmus. They thus form a barrier that must be crossed to enter the branchial region from behind. As this entire region is well covered over by the large opercular flaps and gular pouch, it was at first very difficult to see any significance in such an arrangement. But a few observations in the field soon disclosed the meaning. *Polyodon* is preyed upon, more than any other fish I know of, by the lampreys. To find from ten to fifteen of them attached to one paddlefish is not uncommon, and there is scarcely an individual that bears no scars. Once or twice I observed the lampreys had worked their way under the opercular flaps. Now these, if they worked further forward would encounter the band of scales which would undoubtedly stop them, to judge from their avoidance of scaled areas on other fishes. An examination, however, shows that just inside of this band lies the great branchial artery, but little below the surface. It is evident, therefore, that this band of scales is an important adaptation for the protection of this vital region against attack from so fearful an enemy as the lamprey.

GEORGE WAGNER.
ZOOLOGICAL LABORATORY,
UNIVERSITY OF WISCONSIN,
February 22, 1904.

## CURRENT NOTES ON METEOROLOGY.

### CLIMATE OF THE PHILIPPINES.

IN an article by Gannett on 'The Philippine Islands and Their People,' published in the *National Geographic Magazine* for March, there are some notes on Philippine climate. The mean annual temperatures are not far from 80°, the range between the mean temperatures of the warmest and coldest months at Manila being but 7°. Temperatures of 100° are almost unknown. The lowest temperature on record is 60°. The diurnal range near the seacoast rarely exceeds 15°, and the mean for the year is only 11°. The relative humidity is always high, being usually at least 75 per cent. From November to June the northeast trade, and from July to October the southwest monsoon, is the prevailing wind. Rainfall is much heavier on the windward than on the leeward sides of the mountains. In most parts of the islands the northeast trade wind gives the dry season, and the southwest monsoon brings the rains. The mean annual rainfall varies between 40 and more than 100 inches. At Manila, four fifths of the annual rainfall comes between the first of July and the end of October. Then the streets are flooded, the air is saturated, and things are covered with mould.

### CONDITIONS OF ATMOSPHERE DURING FOGS.

IN *Das Wetter* for January, Elias discusses the conditions of the lower air during fogs, as shown by kite observations at the Aeronautical Observatory near Berlin during the years 1901–2. The results are plotted to show the variations in temperature, humidity and wind with altitude. The most striking fact is that

an increase of temperature with altitude during fog is an exception, and is observed only at the beginning of fog formation, or during very light ground fogs. The usual condition is a decrease of temperature, and occasionally a very rapid decrease.

NOTES.

A paper by Sir J. Norman Lockyer, on 'Simultaneous Solar and Terrestrial Changes,' read before the Southport meeting of the International Meteorological Committee (September, 1903), is published in *Nature* for February 11. In this paper Lockyer reviews the work done along similar lines by previous investigators, and gives the results of his own studies, to which reference has already been made in these Notes.

*Smithsonian Miscellaneous Collections, Quarterly Issue,* July–September, 1903, contains 'Recent Studies of the Solar Constant of Radiation,' by C. G. Abbot.

R. DeC. Ward.

## THE PELÉE CLUB.

The Pelée Club held its second annual meeting at the New Willard Hotel, Washington, D. C., February 27.

This unique organization is composed of men who participated in the events connected with the relief, scientific and news-gathering expeditions to Martinique and St. Vincent. Its original membership embraces about eighty people, including officers of the navy and army, geologists, journalists and magazine writers.

While the club was originally organized to perpetuate the associations and friendships formed during the exciting moments of the Martinique incident, at its first annual meeting it was resolved to make the organization of permanent value to mankind by taking upon itself the function of collecting, as nearly as possible, a complete record of the events of the recent Martinique eruption, and by publishing them in a composite volume, which is well under way.

The society also undertook the collection of all photographs pertaining to the eruptions and relief expeditions, and this has resulted in a collection of nearly two thousand negatives by Professor E. O. Hovey, chairman of the committee on photographs. The society has made the New York Museum of Natural History (the only American institution, except the National Geographic Society, which has exhibited serious interest in the West Indies) the permanent repository for its collection of photographs and records.

Having progressed thus far, the society at its recent meeting still further expanded its functions. Realizing that the subject of volcanic geography in its widest sense, including all branches of interest pertaining to volcanic countries and phenomena, is a wide and unorganized field of cooperative study, the society has resolved to widen its sphere of usefulness by taking up this subject and becoming a permanent organization for its study. Accordingly it resolved to use the present organization as a nucleus for the expansion of the association, to adopt a permanent organization and to expand the membership by taking into the society all investigators interested in the subject of volcanoes.

When the importance of vulcanism in relation to the environment of man, the part it plays in the structure of the earth, and how little is done to systematically study these subjects, is considered, it is evident that the Pelée Club has before it a most interesting and useful study. The character of its membership is unusually favorable for its successful operation, and it is believed that it will especially stimulate interest in the recording of the important geographic observations of the large number of intelligent observers in the army, navy and journalistic circles, while the purely scientific element is also large and influential.

The society has also resolved to use its influence for the encouragement of local organizations wherever they may be and accept as an affiliated society the unique Club Montagne of Guadeloupe, which in the out-of-the-way island of that name has provided an organization for the study of the Grand Soufrière, the highest and most dangerous-looking volcano of the West Indies, and which, at its own expense, has constructed a road to the summit and made arrangements to guide and enter-

tain all earnest students who wish to visit this remarkable volcano. Similar local organizations will be encouraged in the Philippines, South America, Mexico and other volcanic countries, where, by a little encouragement, local observation will be stimulated.

The committee on permanent organization consists of Capt. T. C. McLean, Commander of the League Island Navy Yard, Philadelphia; Professor I. C. Russell, of the University of Michigan; Lieut. Com. J. B. Bernadou, of the U. S. Navy; Major H. J. Gallagher, of the U. S. Army; Professor E. O. Hovey, of the American Museum of Natural History; Professor T. A. Jaggar, of Harvard; Messrs. A. F. Jacacci and George Kennan, the well-known writers, and Messrs, J. Martin Miller, W. M. Mason and J. O. Hammitt, of the press.

The president of the society is Mr. Robert T. Hill, the secretary, Mr. H. H. Smith, and its address is Washington, D. C.

## PRESIDENT ELIOT.

THE following letter with some ten thousand signatures was presented to President Eliot on his seventieth birthday.

March 20, 1904.

*Dear Mr. President:* As with undiminshed power you pass the age of seventy, we greet you.

Thirty-five years ago you were called to be president of Harvard College. At the age of thirty-five you became the head of an institution whose history was long, whose traditions were firm, and whose leading counselors were of twice your age. With prophetic insight you anticipated the movements of thought and life; your face was towards the coming day. In your imagination the college was already the university.

You have upheld the old studies and uplifted the new. You have given a new definition to a liberal education. The university has become the expression of the highest intellectual forces of the present as well as of the past.

You have held from the first that teacher and student alike grow strong through freedom. Working eagerly with you and for you are men whose beliefs, whether in education or in religion, differ widely from your own, yet who know that in speaking out their beliefs they are not more loyal to themselves than to you. By your faith in a young man's use of intellectual and spiritual freedom you have given new dignity to the life of the college student.

The universities and colleges throughout the land, though some are slow to accept your principles and adopt your methods, all feel your power and recognize with gratitude your stimulating influence and your leadership.

Through you the American people have begun to see that a university is not a cloister for the recluse, but an expression of all that is best in the nation's thought and character. From Harvard University men go into every part of our national life. To Harvard University come from the common schools, through paths that have been broadened by your work, the youth who have the capacity and the will to profit by her teaching. Your influence is felt in the councils of the teachers and in the education of the youngest child.

As a son of New England you have sustained the traditions of her patriots and scholars. By precept and example you have taught that the first duty of every citizen is to his country. In public life you have been independent and outspoken; in private life you have stood for simplicity. In the great and bewildering conflict of economic and social questions you have with clear head and firm voice spoken for the fundamental principles of democracy and the liberties of the people.

More precious to the sons of Harvard than your service as educator or citizen is your character. Your outward reserve has concealed a heart more tender than you have trusted yourself to reveal. Defeat of your cherished plans has disclosed your patience and magnanimity and your willingness to bide your time.

Fearless, just, and wise, of deep and simple faith, serene in affliction, self-restrained in success, unsuspected by any man of self interest, you command the admiration of all men and the gratitude and loyalty of the sons of Harvard.

## SCIENTIFIC NOTES AND NEWS.

THE annual stated session of the National Academy of Sciences will be held in Washington, D. C., beginning on Tuesday, April 19, 1904.

To celebrate President Eliot's seventieth birthday, Harvard graduates and students have subscribed $5,000 for a portrait or bust to be placed in the Union.

DR. S. P. LANGLEY, secretary of the Smithsonian Institution, has been made a corre-

sponding member of the Reale Istituto Veneto.

Professors Joschikijo Koganei and Tsuboi, of the University of Tokyo, have been made corresponding members of the German Anthropological Society.

Dr. J. H. van't Hoff, the eminent chemist, has been made an honorary doctor of medicine by the University of Utrecht.

Dr. Heinrich Caro, of Mannheim, who celebrated his seventieth birthday on February 13, has been given the honorary doctorate of engineering by the Technical School at Darmstadt, in view of his contributions to chemical science and industry.

Professor F. L. Knapp, formerly professor of technical chemistry at the Technical School of Brunswick, has recently celebrated his ninetieth birthday.

At the request of the Peruvian government, the U. S. Geological Survey has sent Dr. George I. Adams to Peru to organize a service for hydrographic work.

Dr. N. L. Britton, Mrs. E. G. Britton and Dr. M. A. Howe, of the New York Botanical Garden, are now engaged in a collecting expedition in Florida and in the Bahamas, using Miami as a base of operations.

Dr. D. T. MacDougal has returned from Sonora and Baja California, where he recently carried out some explorations. In addition to the observations and collections of vegetation valuable data concerning temperatures and relative humidity were obtained.

Dr. Arthur Hollick has obtained leave of absence from the New York Botanical Garden in order to examine and report upon a collection of fossil plants representing the Cretaceous (Island series) flora of Staten Island, Long Island, Block Island and Martha's Vineyard for the U. S. Geological Survey.

Dr. James Ward, professor of philosophy at Cambridge, will lecture before the summer school of the University of California. He will be one of the speakers before the Congress of Arts and Science of St. Louis, and will subsequently visit some of the eastern universities.

Professor Maragliano, of Genoa, was unable, owing to illness, to come to this country and give the lecture on tuberculosis before the Phipps Institute of Philadelphia, which had been announced for March 28.

Mr. Overton W. Price, of the Bureau of Forestry, has been appointed lecturer in the Forest School of Yale University.

Mr. Stewart Culin, of the Brooklyn Institute, on March 24, gave in the Fogg lecture-room of Harvard University the first of a series of three lectures arranged by the Anthropological Club, speaking on 'Recent Anthropological Investigations in the Southwest.' On April 12, Professor A. F. Chamberlain, of Clark University, will speak on 'What Our Civilization owes to the American Indian'; and shortly after the spring recess Mr. H. I. Smith, of the American Museum of Natural History, New York, will give an address on 'Recent Anthropological Investigations on the Northwest Coast of America.'

It is announced that the following have consented to lecture before the Carnegie Technical School at Pittsburg: Professor C. L. Mees, president, Rose Polytechnic School, Terre Haute, Ind.; Miss Helen Kinne, Teachers College, Columbia University, New York; Harriet Sackett, Pratt Institute, Brooklyn; Professor Warren P. Laird, University of Pennsylvania, Philadelphia; Professor W. T. Goldsborough, Purdue University, Lafayette, Ind.; Professor W. F. Durand, Cornell University, Ithaca, N. Y.; Professor C. F. Binns, Alfred University, Alfred, N. Y.; Professor Robert H. Richards, professor of mining and metallurgy, Massachusetts Institute of Technology, Boston; Professor James Russell, dean of Teachers College, Columbia University, New York City; H. H. Moek, mines and minerals, Scranton, Pa.; William E. Gibbs, consulting engineer, New York, and Professor C. F. Chandler, Columbia University, New York.

We have noted the death of the well-known zoologist, Professor Fredrik Adam Smitt, which took place at Stockholm on February 19. Born on the ninth of May, 1839, at Halmstad, he took his doctor's degree at Upsala in 1863, and became docent in zoology at that uni-

versity. While in this position he joined Torell and Nordenskiöld in their expedition to Spitzbergen in 1861, went with Nordenskiöld's expedition to Beeren Island and Spitzbergen in 1868 and accompanied the frigate *Josefine* on her voyage to the Azores, England and North America in 1869. On the death of Professor Sundevall in 1871 Smitt, though only thirty-two years old, was appointed to succeed him as professor and intendant at the Natural History Museum of the state. Smitt wrote several papers on marine invertebrates, notably bryoza, but it was for his work on fish that he was best known, especially his critical list of the Salmonidæ in the state museum. Of late years he had paid much attention to the gobies. His scientific knowledge was freely bestowed in attempts to help the Swedish fisheries.

DR. KARL SCHUMANN, titular professor of botany at Berlin and curator of the Royal Botanical Museum, well known for his contributions to our knowledge of flowering plants, has died at the age of about fifty years.

WE regret also to record the death of Henry Perrotin, director of the Observatory at Nice at the age of fifty-eight years; of Dr. W. W. Markownikow, professor of chemistry in the University of Moscow; of Dr. Hermann Emminghaus, formerly professor of psychiatry at Freiburg, at the age of fifty-nine years, and of Dr. L. Beushausen, docent of paleontology at the Berlin School of Mines, at the age of forty-one years.

THE French Association for the Advancement of Science will hold its annual meeting at Grenoble beginning on August 4, 1904, under the presidency of M. C. A. Laisant.

THE following have been elected as an organization committee of the American Bibliographical Society: *Chairman*—Worthington C. Ford, Library of Congress, Washington, D. C.. *Secretary-treasurer*—George W. Cole, New York City; Wilberforce Eames, Lenox Library; A. G. S. Josephson, John Crerar Library; Azariah S. Root, Oberlin College Library.

ON April 19, there will be an examination for the position of scientific assistant, qualified in library science in the Bureau of Chemistry, at a salary of $840. There will also be held on April 19 an examination for computors and for aid and deck officers in the Coast and Geodetic Survey. On April 19 and 20, there will be an examination for the position of librarian in the U. S. Coast and Geodetic Survey, at a salary of $1,800. Further information in regard to these examinations can be obtained from the Civil Service Commission, Washington, D. C.

BILLS have been introduced into the Senate and the House of Representatives incorporating the Carnegie Institution of Washington.

ACTIVE preparations are being made at the New York Zoological Garden in Bronx Park for taking the animals out of winter quarters. Work is also being pushed with all possible speed on several new houses in the garden, the most important of which are the bird house, to cost $115,000; the small mammal house, to cost $38,000, and the ostrich house, to cost about the same sum.

Two physicians of the Hamburg Institute for Tropical Diseases—Drs. Otto and Neumann—have gone to South America for the purpose of studying yellow fever. They are supplied with considerable means furnished by shippers and merchants of Hamburg. In addition to scientific studies they are to collect information with reference to the new preventive measures now used in South America against yellow fever, and to devise means to prevent the heavy damages which the German merchant marine has suffered in the several years of yellow-fever epidemics.

MR. HENRY GANNETT, geographer of the United States Geological Survey, has recently received numerous letters of inquiry regarding the proper spelling of the place names in Korea and Manchuria that have become prominent. Mr. Gannett suggests that the matter would be much simplified if it were generally known that a system of transliteration of such names has been adopted by most European nations, by Canada and by this country. This plan is published in the Second Report of the United States Board on Geographic Names. The rules adopted by

the Board on Geographic Names provide that the vowels shall have the sounds that are common to the vowels in the languages of southern Europe. It follows, therefore, that *u* has the sound of *oo* in boot and that Manchuria is therefore preferred to Manchooria, Chefu to Chefoo, Amur to Amoor. It has been ruled that *ai* has the sound of *i* in ice; *au* the sound of *ow* in how (*ao*—a very frequent combination in the East, heard in names like Mindadao and Nanao—is slightly different from the preceding); *ei*, as in Beirut, has the sound of the two Italian vowels, but is frequently slurred, when it is scarcely distinguishable from *ey* in the English word they. In accordance with the rules, *c* is always 'soft,' having the sound of *s*. 'Hard' *c* is represented by *k*, and it therefore follows that Korea is the accepted form, and not Corea. Other rules are that *ch* is always 'soft,' as in church; *f* is sounded as in English and *ph* should not be used to represent this sound; *g* is always 'hard,' as in get; *h* is always pronounced; *j* and *k* have the English sound; *kh* has the sound of the oriental guttural; *gh* is another guttural; *ng* represents in different words different sounds—two sounds, as in finger, and one, as in singer; *q* should never be employed for the sound of *qu*, which is represented by *kw*, as in Kwantung; *y* is always a consonant, as in yard.

The Boston Society of Natural History has undertaken to publish a series of lists of New England animals to form a volume of its Occasional Papers. These lists will be issued at irregular intervals, and are considered a necessary preliminary to more exhaustive monographs on New England animals, the publication of which the society hopes at some future time to undertake. To facilitate the preparation of these catalogues, the cooperation of persons interested in the fauna of New England is invited. Any New England specimens for the society's museum should be sent to Mr. Charles W. Johnson, curator, and all notes, records, etc., to Mr. Samuel Henshaw, editor of 'New England Fauna,' in care of the society, Boston. The first two parts of the projected volume, containing lists of the Reptilia and Amphibia, are now in press.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

Sir William McDonald will give $100,000 to McGill University to establish a students' union hall.

The Chicago Board of Education proposes to build, at a cost of $500,000, a commercial high school on the lake front.

Our consul at Bahia writes that the state of Bahia is about to organize a school of mines and wishes to arrange for a competent professor of mining. The state will make a contract for three years to pay the equivalent of from $3,000 to $4,000 a year as salary, with free transportation. It will be necessary that the applicant be a graduate of some recognized American school of mines and that he have both a practical and theoretical knowledge of mining. A speaking knowledge of Portuguese or Spanish is preferred, but lack of such will be no bar to a good man. Applications should be addressed to Dr. Miguel Calmon du Pin e Almeida, Secretario da Agricultura, Industria, etc., Bahia, Brazil, or may be sent to the consulate for delivery.

The report of the members of Mr. Moseley's education commission to the United States will be published on April 9. It will contain about 600 pages and will be published at the nominal price of one shilling.

Examinations for the Cecil Rhodes scholarship at Oxford will be held in the various states on April 13.

Mr. Alexander Smith has been made professor of chemistry and director of general and physical chemistry at the University of Chicago.

Dr. Max Mason, of the Massachusetts Institute of Technology, has been appointed instructor of mathematics in Yale University.

Dr. Karl Wernicke, professor of psychiatry at Breslau, has been called to Halle to fill the chair vacant by the removal of Professor Th. Ziehen to Berlin.

Dr. K. S. Semström, professor of physics at the University of Helsingfors, has retired from active service.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 8, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y

## THE TRAINING OF TECHNICAL CHEMISTS.*

THE world's growth in manufacturing industries has increased enormously during the last century. This marked progress has resulted from a greater and more widely diffused knowledge of the sciences and their application. In this great advance the United States, aided by her wonderful and vast natural resources, has taken a very important part. In 1850 the value of manufactured products in the United States was $1,000,000,000. This has increased to the astonishing figure of $13,000,000,000 in 1900, while the value of unmanufactured agricultural products was estimated at $4,000,000,000.

In bringing about this increase, chemistry, assisted by engineering, has played a most important part. Our iron and steel industries, our whole field of metallurgy and, indeed, the majority of the great industries, would have remained in a crude, dormant state had it not been for the important work of the chemist and his more practical brother, the technical chemist. When we realize that the value of our manufactured products is three times as

* Paper read at the meeting of the New York Section of the American Chemical Society, February 5, 1904.

great as our agricultural products, it is plain to see the vast importance of the work of the chemist, and especially the technical chemist, in the successful operating, maintenance and improvement of our manufacturing industries.

It will be inferred from this statement that the number of chemists engaged in active work in this country has greatly increased. It is a fact that in the last thirty years they have increased in a proportion far beyond that of the increase in the value of manufactured products. It is interesting to note also that their importance is more and more recognized. Twenty years ago there were many establishments turning out manufactured products where no chemists were employed; these firms have since engaged chemists, with the result that a marked saving in the costs and improvement in the quality of the goods produced has been effected.

We are still very backward in this country in the employment of chemists when we compare our position with that of Germany, especially in the chemical industry itself. It is not uncommon in Germany for one concern (as in the Badische Anilin und Soda Fabrik) to employ over 400 chemists. We find in Germany that the highly educated technical chemists have done remarkable work in improving the chemical industrial condition of that country, placing it far ahead of all nations in many branches, such as the great coal tar color industry.

In the industrial strife which has been waging for some time between Germany and England, the former has gained on account of the fact that technical education is more widely diffused in Germany than in England. As an instance of this I quote an extract from the *Spectator* of December 5, 1903, being a reprint of a speech by Mr. Haldane before the Liberal League, wherein he explains that the industries of England have declined, not because the goods manufactured are kept out of foreign markets by protective duties, but because the goods themselves are inferior to those produced in foreign countries:

"The German manufacturers make a finer quality of cellulose than the English manufacturers. We have not yet succeeded in making it so white as they do, and for many of the uses to which celluloid is now put, whiteness is an essential quality. How did the German manufacturers set about obtaining this whiteness? 'Twelve of them,' says Mr. Haldane, 'combined together and put down £100,000, providing besides £12,000 a year, and in one of the suburbs of Berlin, near the great university, founded an institution which we have nothing like in this country. They had the most distinguished professor of chemistry they could get from the University of Berlin at the head of it; they gave him a large salary; they employed under him the best highly technically trained assistants that the university and the technical schools of Berlin could produce. * * * Whenever they had a problem, whenever they found that the British manufacturer was making his celluloid a little whiter, they said to their experts, 'Will you show us how to make ours whiter still?' The investigators were set to work and we were beaten nearly out of the field."

In this country there are numerous examples where the technical chemists have immensely improved manufacturing conditions either by lowering costs or by producing a higher quality of product. There is still much room for improvement, and I venture to say there is hardly a plant in the country turning out products requiring chemical skill where marked improvements could not be made by the very best work of technical chemists, in effecting changes that would reduce the cost of labor and

fuel, in recoveries from waste products or by producing better material.

Before deciding on the best methods of training our technical chemists, we must see that they are sufficiently educated in the proper lines to enable them readily to become technical chemists of great value. During my long experience in connection with chemical manufacturing and metallurgical work I have been forced to the full realization that the majority of chemists who are employed as analysts, technical chemists and as works or department managers, have perfected themselves in chemistry alone and seem to have neglected the importance of physics and engineering. If one wishes to achieve the greatest success in such work he should not undertake the problem at all unless he has made up his mind to perfect his mathematics and become thoroughly familiar with physics as well as mechanical engineering.

It seems a great mistake that the term technical chemist has been used in connection with chemists who are obliged to apply chemistry in manufacturing processes. It would have been better had they been called chemical engineers, for this might have induced the study of chemical engineering in the colleges many years ago. I feel certain that, had this been done, our industrial situation would have been much further advanced than at present, and the standing of practical chemists would have been higher and their value more highly esteemed than is the case. We do not speak of a metallurgist as a technical metallurgist, a miner as a technical miner, or an electrician as a technical electrician. The metallurgist is, properly speaking, a metallurgical engineer, the miner a mining engineer and an electrician who applies electricity, an electrical engineer. In all of these positions it is impossible to succeed without a full knowledge of mechanical engineering. The same is true in the application of chemistry. It would appear that when young men aspired to become chemists they looked upon the great chemists as supreme beings. They also considered mechanical engineering, with its machinery, machine shop, foundry, etc., as beneath the dignity of the chemist; they left college knowing nothing of mechanical engineering, and of course were totally unfit to take positions as works managers or wherever it became necessary to apply chemistry in a large way. I have known cases where young men, who were exceedingly clever as chemists, but totally ignorant of engineering and as unpractical as one could imagine, were placed at once in positions of practical responsibility in small chemical works. No more cruel act could possibly be done to the chemist. The business managers were not practical and had studied neither engineering nor chemistry. Of course many of the chemists who were placed in such positions proved utter failures, and for this reason many of the practical business men twenty-five years ago doubted the value of chemists in connection with manufacturing. Had these young chemists been chemical engineers and had the business managers received a moderate education in mechanical engineering and chemistry, the combination would have resulted in a marked success instead of failure.

When we notice the enormous field in manufacturing in this country one can not help feeling that the study of mechanical engineering should be very much more general than at present. I have known chemists who had not studied engineering, who, when placed on practical work, realized their deficiencies and took a course in mechanical engineering at night schools in order to enable them to properly apply their chemical knowledge. After men have gone through a regular course in chemical engineering they should be

trained, as far as possible, before leaving college in a thoroughly practical manner in the application of chemistry as well as in examples of engineering problems.

The greater the application of chemistry, the more important becomes the combining of mechanical training with chemical training. Our colleges should consider this matter more seriously than ever, and do their best to make the course in chemical engineering as complete and perfect in every way as possible. This is a duty they owe to our young men who desire to make a success in the great field of chemical engineering; it is a duty they owe to the manufacturers of this country who are doing their best to rival successfully the highest European competition and obtain our full share of the markets of the world for our manufactured products. Many of our manufacturers would receive the highly educated chemical engineer with open arms, and as a proof of their earnest belief in the importance of this matter they would gladly make necessary endowments to assist the colleges in carrying out this important work. The colleges should court their assistance by receiving all the practical suggestions that would enable them to readily turn out men so well educated and trained that they would very easily become valuable chemical engineers.

Chemical engineering necessitates a greater variety of engineering than all the other branches of engineering combined. In designing the apparatus that is employed in conducting the endless variety of chemical and metallurgical processes, every known metal and alloy is used in every conceivable variety or form. All kinds of brick are used, acid, basic, neutral and vitreous, glass, all sorts of pottery-ware, porcelain, stone, rubber, coke, asphalt, wood, cements, etc., and these in every combination and form which the best chemical engineering skill can devise to improve old methods and properly conduct new processes. In order to select the best material with which to carry on difficult problems, the chemical engineer must have a wide knowledge of the action of acids, alkalies and chemicals under all conditions of solution and heat, upon all known substances which could be employed to carry on the processes. Generally in new problems, carefully conducted investigations have to be made on a small scale, to show conclusively the best substances to be used.

In the designing and construction of plants and apparatus the chemical engineer has not only to select the most suitable material, but he must so carefully study the function of every detail of the apparatus to be used, that each part will successfully meet the full requirements. Each and every part must be proportioned to what it has to do; everything must be proportionately strong and large enough for the purpose, always avoiding unnecessary extremes in order to curtail the first cost of the plant. The desired end must be met in the simplest possible manner and the devices so arranged that while operating they will be so nearly automatic that good results will be achieved with the least possible labor. The plants must be so designed that the greatest yields will be obtained and the finest products turned out.

But after all this is done the chemical engineer will not be thoroughly skilful and up to date unless he designs every part of the apparatus so that it will last the longest possible time. Everything must be arranged so that when repairs are required they can be conducted with the least expense.

For the successful operating, maintaining and improving the condition of plants where chemical skill is employed, the manager or superintendent and his assistants

must be trained not merely in chemistry, but in mechanical engineering as well. Training in business and departmental management is also highly desirable. However perfectly a plant and its apparatus may be designed and erected, it will not necessarily give successful results unless every machine, furnace, still, condenser, tower, etc., is operated under the management of a man who is fully conversant with the function of every detail of the apparatus. In order to obtain in every way the best possible results, the superintendent is greatly handicapped if he has not received a full education and practical training in chemical engineering. Without the proper scientific knowledge that governs all the operations, he never fully understands the true reason for all the things that are done under his control. The inevitable outcome of such unintelligent management results in the continuance of a low standard of skill in all the working force under him. The apparatus is not run to the best advantage, thus lowering the quality and raising the cost of the goods produced. On the contrary, if the superintendent is properly educated in chemical engineering and has had a proper training as an assistant superintendent or practical investigator, and especially if he has a natural fondness for machinery and mechanics, then success will crown all his work. Whenever there is a difficulty—something breaks down and bad results follow—then he will at once clearly define the reason for the trouble and take the proper steps in completely correcting the evil. He gives true reasons for everything that is done in the various departments of the plant. He sees much going on that is unreasonable, and step by step he brings the unsatisfactory work up to a higher and higher standard. His assistants are chemical engineers, and he inspires great confidence and interest in them by a course of training that causes them to think and reason from every standpoint, so that before taking action, everything having an important bearing on the chemical, physical, engineering, business and labor sides of the problem in hand is most carefully considered.

By such a course of training the young men learn to think systematically and, guided by a master of the art, they rapidly learn to make the best use of their education in applying it to important practical work. It is quite natural for the impulsive youth to put into practice the first thought that comes to his mind. In the practical training that he should receive I must impress upon you the importance of making him consider every problem most carefully and from all sides, before taking action. In this manner he will acquire a habit of not acting quickly or without deep consideration. You will find that men who have thus been made to think and reason broadly and in a systematic manner, will put into practice what may be considered good sound judgment. Such men are bound to make a success in the practical application of their chemical engineering.

In a large chemical or metallurgical works, or any other establishment where the processes are controlled by chemical analysis and where the raw and finished products are bought and sold for values governed by analysis, it is necessary to have a well-appointed chemical laboratory. In large plants where many chemists are employed, an able chemist should be at the head of the analytical as well as the research laboratory; the chemists in the analytical laboratory are not always college graduates, as most of the work is of a routine nature, requiring great skill in manipulation but not necessarily an extensive knowledge of chemistry. These men, when confined to this work, have no opportunity to employ engineering skill ex-

cept in perfecting the apparatus used in making chemical analyses. It is of the utmost importance that their analyses are accurate and quickly performed. On very important work, such as analyses made for settlements on raw material and finished products, analyses are run in duplicate and settlements made on a split between the buyer's and seller's results. This competition encourages very accurate work on the parts of the analysts, and they become very skilful.

It is the custom in all well-managed industrial laboratories to investigate frequently the analytical methods used, in order to determine their accuracy, reliability, ease and quickness of performance. Old methods of analysis are thus improved, new methods invented and the new methods of others compared and adopted, if found the most suitable. For this reason it is not uncommon to find the most desirable analytical methods used in the laboratories of our important industrial establishments. The colleges would do well to look into these methods as far as possible, and thus keep abreast with the best practice to aid them in teaching analytical methods.

There is no reason why the training of analysts in large laboratories should not be of the highest order. It is a great mistake to allow the standing of the work done in these laboratories to run down. It is a grave error to economize too much in the laboratory by employing too few analysts and thus prevent the practical managers from receiving all the information required to control intelligently the various processes in the factory.

After men have been a few years in an industrial laboratory they, as a rule, desire positions in the works. It is the exception when we find a chemist from college who has studied mechanical engineering; for this reason only very few chemists become good candidates, qualified for giving proper attention to large factory processes where the many complicated devices require engineering as well as chemical skill. I have known many of the men in a laboratory to study mechanical engineering either at night schools or with correspondence schools. It would have appeared the part of wisdom for such men to have taken a course at college in mechanical engineering as well as in chemistry, thus fitting them for a wider field of work in their chosen vocation, and affording an opportunity to make greater advancements.

The future success of any well-established industrial institution of a chemical nature is in grave peril if it does not have an investigation or research department. The manager of this department must be by education a chemical engineer. He should have had much experience as a practical business manager of plants, and a direct acquaintance in the designing, reconstruction and repairs of the same. This department must have a properly equipped research laboratory. The head of this research laboratory must be possessed of very high attainments as a chemist and physicist, with a fair knowledge of mechanical engineering. His work through life will be stamped with the greatest success if he has been trained at college in methodical methods of thinking, as applied to original work, and to many examples of practical investigation and experimentation. The chemists under him should have received the same education and training at college. It is desirable that this department should have the capacity to investigate new processes that are presented, and if they look promising, a small working plant should be constructed and operated by them to prove fully the value of the method and to give the necessary practical data to be used in the designs of a large and fully equipped plant. This department will keep in touch with every-

thing that is published, in either technical journals or patent reports, having a bearing on the work under consideration. All the processes in the company's works will be carefully investigated by them, to locate and devise means for preventing losses in gases, liquid and solid waste material, and thus increase the yield of the useful products. They work up methods for making useful products from waste material. Much of their time is occupied in working up means for improving the quality of the various finished products. They are also busily engaged in working up new processes, putting the same into practice, and thus entirely supplanting the old methods.

It will be seen from these remarks that to become a skilful or trained investigator in a research chemical laboratory requires:

1. A proper education at college as a chemical engineer, especially full in chemistry.

2. Training at college in original thought as applied to practical investigation, and to working up and improving processes.

Some of you feel that it is a mistake to divide the work of one man between chemistry and mechanical engineering; that the chemist must be solely a chemist and the engineer an engineer alone. I admit that a very small proportion of the chemists have to devote all their time to pure chemistry, and in certain lines of theoretical and research work. The great majority of chemists in this country, however, are engaged in practical work where they need engineering assistance, and in such cases the chemist who is not an engineer would have to consult the engineer for practical advice, and the engineer seeks chemical assistance from the chemist and without a knowledge of chemistry obtains but little satisfaction.

My experience forces me to feel that a complete understanding of the various problems must come from a brain that can think in both chemistry and engineering. The dignity and fame of chemistry will not be injured by joining in close union with engineering. Indeed, the real value and glory of chemistry come from its application to useful products that add comfort and happiness to the human race. These applications can not be carried on without the aid of engineering.

Applied chemistry would be greatly benefited in this country if the colleges would come in closer touch with the manufacturer. The professors of chemistry and mechanical engineering would do well to study more carefully the educational requirements as found in some of our large works, where the advantages of a well-directed knowledge of chemical engineering are clearly shown. I am sure the broad-minded manufacturers would gladly cooperate in this important work, seeing plainly that it must result in a general advantage to our industries, and to the industry and prosperity of our whole country. The best way to carry on this work would be to employ a plan that has been in successful practice at Brown University for the last few years. They carefully select from their alumni a separate committee for each department of study. These committees visit the college once or more a year; they consult and exchange views with the heads of the departments they represent. Each member reports his recommendations to the chairman of his committee, who incorporates the same in his report to the president of the college. I am a member of the committee appointed to assist the chemical department of Brown University. I recommended to them to have a course in chemical engineering, and, indeed, outlined a four-year and a five-year course, giving the number of hours per week for each study.

The more perfectly and completely chemistry is applied by engineering assist-

ance, the greater will be the volume of manufactured products and the larger will be the field for chemistry. May Americans stand foremost among the nations of the world in turning out chemical engineers having such great ability that they can easily lead our manufacturers to an unapproachable pinnacle of greatness and perfection. May the chemists of the American Chemical Society ever be leaders in this great work, and may their name and fame remain to the end of time a living monument to industry, progress and prosperity.

J. B. F. Herreshoff.

DISCUSSION.

Mr. T. J. Parker.

It seems to me the keynote of the discussion was struck by one sentence in the address, which was to the effect that the marvelous development of industrial chemistry in this country is due to the work of the chemical engineer. I do not see from my standpoint how the dual existence of the engineer and the chemist is necessary for the higher development of the chemistry and mechanics of the industry committed to the charge of the competent technical chemist. The important question arises, therefore, What shall we do to properly equip the young men who are annually turned out from our technical schools and colleges?

From the experience of many here present they could no doubt tell you of men who have been brought up in mechanical pursuits, not as chemists, and whose practical knowledge of chemistry was acquired after they had left college, who have made very successful men, because they had mechanical ability to apply the investigations and discoveries of the scientific chemist to the requirements of the manufactures or arts under their charge. If the application of chemistry to manufacturing processes is desired, it is certainly necessary for these young men to have a knowledge of mechanics or engineering as well as chemistry, in order to apply it efficiently in our factories.

The opening for the industrial chemist in the next five or ten years is simply phenomenal, judging from what we have heard here to-night.

Mr. M. C. Whitaker.

On the technical staff of a manufacturing establishment you will find a civil engineer who lays out the grounds and devises new construction, and you will find a mechanical engineer who plans his boilers and his new engines; both of these men, in the opinion of the superintendent, are very important individuals. The electrical engineer sets up his dynamos and places his motors. He devises new and ingenious electrical apparatus, and he, in the mind of the superintendent, is also a very important individual. Now, when the processes connected with these manufacturing industries are referred to the chemist for improvement, he repairs to his laboratory, and we all know that he goes through some very serious, painstaking work. This work is not appreciated by the superintendent because he is not a chemist. What the superintendent asks for is actual merchantable results. The chemist is generally not a man who is capable of transmitting from a laboratory to a factory the ideas which he has developed. He is not educated in the engineering branches which have been so much emphasized here this evening. He should have a knowledge of electrical engineering and bring it to bear in the proper solution of problems coming before him. He should have such a knowledge of mechanical engineering as to bring to bear the best mechanical devices. Furthermore, and in my mind the most important of all, he should have that knowledge of getting along with

people so developed that, after he has prepared his plans and laid them out, he can get the help to bring about the results which he desires. This is a very important step, but the point I have tried to make is that the man must not only have the knowledge to develop new ideas, but he must have the knowledge to put them into practise. Now, we see that those men who have by themselves obtained this engineering knowledge, either before or after studying chemistry, are the men who make a fair success. Therefore, it seems to me very important that we should do all we can to help to produce the kind of a chemist that I have named—a chemical engineer. A man who has such a knowledge of chemistry, of electrical and mechanical engineering, of metallurgy and of the handling of men as will enable him to go into a laboratory and develop a process, and then put it into operation and deliver to his concern a merchantable result, will have that recognition on the payroll which he deserves. In other words, I think that these men, instead of being assistants in our manufacturing industries, will be leaders.

Dr. William McMurtrie.

Those of us who have had experience in the applications of chemistry in a large way have long recognized the truth that to be successful in the chemical industries in this country one must be at the same time a chemist and an engineer. One must know thoroughly not only the reactions involved in a particular industry and the laws of chemistry which govern them, but must have intimate acquaintance with the mechanical means whereby the reactions may be carried out in a large way.

I know full well that teachers in the educational institutions object that the time allotted for the training of young men for the chemical industries is too short to cover both the branches of work indicated, and most or all of us are prepared to admit that this objection is valid. Part of the difficulty is due to the fact that those charged with this training have to do with raw material in the student which is far too raw; that students present themselves not properly prepared for the work before them. I, therefore, believe that the training of the technical chemist, as well as that of every technical and professional man, should begin much earlier than the entrance to the technical school. It should begin even in the earlier grades of the primary school. Here the idea should be abandoned that the young minds are too immature for serious study and systematic work; that the children need to be amused rather than seriously educated; that they must be trained by kindergarten methods in lines which must later be traversed again in the serious struggle for education. And thus precious time is lost at the age when the mind is most pliable and receptive.

It would be far better to return to the old-fashioned methods of careful study of the three R's. The children should be taught first of all to read understandingly; to write clearly; to comprehend readily the great truths of literature and science, whether expressed orally or in print. Then they should have continued training in mathematics, the successful study of which involves careful and systematic thought and work. The result sought in any calculation in mathematics is always most definite, and the attainment of an accurate result involves careful attention to every detail. For this reason the study provides splendid preparation for successful work in any profession or in business, in the research laboratories or in the wider fields of the applications of science—the great manufacturing and engineering works.

So then let the children begin serious and systematic work early; let them be so trained that work once done need not be repeated; let them come to the technical

school with thorough and careful training first, in general culture, in language and literature, then in mathematics, and finally give them the advantage of the splendid courses provided in our technical schools in chemistry and engineering, and they will be prepared to meet effectively and successfully the great problems the chemical industries of the immediate future will have ready for them. That what is needed can be fully accomplished in a course of four years I doubt, but it may be helped by the preparation I have outlined. That the technical chemist of the future must know thoroughly the great laws of chemistry and at the same time be well grounded in the principles of engineering I do not doubt. And I am satisfied that justice to the young men, as well as to those who must employ them, demands that time for all the training I have outlined should be provided.

Professor Edward Hart.

It seems to me that we must in the first place reconcile ourselves to the idea of doing the best we can in four years. I am one of those who do not believe very much in post-graduate courses for chemical students. There are many who must have a post-graduate course, of course, but if you take the ordinary man and follow the history of such ordinary man, the man who passes through college and makes afterwards a success, you will find that very many of them were poor boys. They haven't the money to take more than a four years' course. If we are to turn out such men we must educate them, as far as we can, in four years. How are we going to do it? We must limit the number of our subjects. We must attempt and to a large extent succeed in teaching those things that we attempt to teach well and not attempt to teach too many things, and that involves a very careful selection of one part of the equipment to which I am sure too little attention is often paid, and that is those who take part in the work of teaching. I have had considerable experience in teaching. I have had very few assistants who did their work faithfully, very few. It is a very tiresome, thankless business to teach a lot of beginners, and it very seldom happens that before the end of two years of such work the man doesn't lose a part of his enthusiasm and do his work less well than it should be done. This work must be done well if we are to succeed in turning out the class of men that we want, and it is this work which determines very largely the quality of our product, for there is no truer thing in the world than that the student is largely the product of the self-sacrifice of his teacher. We must first teach the science of chemistry, so far as it is possible, and we must teach it thoroughly and well, because we can't go too far, and then we must teach engineering, because the chemical manufacturer is an artisan. He must be an artisan to a certain extent. I do not believe, however, that in the four years' course it will be possible to get into such a man more than the elements of engineering, but if these things are done well I am quite sure that the product will be quite different from the product that is turned out at the present time.

Professor W. A. Noyes.

The discussion thus far has dwelt almost exclusively upon the necessity that the chemist should know many things besides chemistry and especially that he should know mechanical engineering, and with all that phase of the discussion I most heartily agree.

With regard to the chemical side of the work we are in as great difficulty, almost, for lack of time as with regard to the accessory side of it. Chemical science has expanded enormously in the last twenty-

five or fifty years. It is as impossible to-day to know all chemical science, even in a general way, as it was fifty years ago to know all the sciences. Chemistry has so wonderfully developed in so many different directions that it is impossible for any one to cover the whole field. It is necessary, therefore, for the colleges to choose, in this large field, what shall be taught. Now, the basis of the training for the technical chemist and for the chemist of all kinds, must be a thorough training in analytical chemistry. I believe that the training in this particular field has become inferior to what it was a few years ago. Results that have come to my knowledge, and no doubt to the knowledge of others of you, during recent years, of the way in which chemists fail in comparatively simple analytical problems, show that the training of the chemist is not always what it should be. Another important question which comes before the teacher in the college is, How much training in industrial chemistry can be given to the student. It seems to me that comparatively little in that particular direction can be done, especially in a four years' course. It is important that the student shall have a thorough training in the fundamentals of the science and a thorough training in analysis. If that training is given, it is impossible to crowd into the four years' course any very considerable training in industrial questions. Another fact which makes any long or extended training in industrial questions inadvisable, as well as impossible, in the college course, lies in the extremely wide range of work in which these young men are going to engage, and, in a majority of cases, from the difficulty of telling what work the particular individual will do after he gets out of your hands. It is manifestly impossible, therefore, to train him for that particular field into which he will go. He must of necessity gain his special training in that field after he enters it.

PROFESSOR C. F. CHANDLER.

The difficulty is that our students come to us for four years. They never know what particular branch of chemistry they intend to pursue in after life. We are compelled, therefore, to treat them all substantially alike, and give them all substantially the same chemical education. Now, it is not possible in four years to do a great deal more than to lay the foundations of a chemical education, particularly if you want to devote some time to giving the students a good training in mathematics and various other branches which go to make up a complete chemical education. It seems to me as if the work of making the chemist was put entirely upon the instructors. The student expects the instructors to do the work. We suggested that we might increase the number of assistants, and let them make the analyses for the students. When I was a student I went into Wöhler's laboratory. He gave us a lecture every morning and we were expected to attend that lecture and make the most of it. Then we went into the laboratory. He handed me a piece of triphyline and said: 'I want you to get some lithia out of that.' He did not give me an hour's lecture and tell me how to make lithia and have me write it down. He gave me a piece of the mineral and I had to hustle and find the solution of the problem myself. He said: 'You have to make some lithia out of that, and after you have made up your mind, come to me and I will look over your proposition and see whether it is right.' That was the way chemistry was taught in Wöhler's laboratory. There was a small number of students and that method of instruction was carried out. We had seven hundred students working in our chemical laboratories

last year, and, of course, it is extremely difficult to give each student much personal attention. I think that one great difficulty is that somehow or other we have rather drifted into the condition that the student expects the professor to tell him everything that he has to do. I worked in Rose's laboratory for a year, making mineral analyses. He never told me how to make an analysis. He handed me a piece of mineral, samarskite, for example, and told me to find it out myself. I read everything I could find that had ever been written on the subject. I found out the best methods known for analysis. That was the system of those days. Now, the students expect us to stand up in the lecture room and tell them every step in the process of making an analysis. They must be told to weigh a gram and a half of this, and add this and that to it, so many cubic centimeters of this and so many of that, and they must do this, that and the other thing; and unless you tell the student every step of that kind, he can not make the analysis.

I quite agree with everything that has been said upon the subject of adding to the instruction of the chemist a sufficient amount of engineering to enable him to rise to the dignity of superintendent or manager of large works, but I do not think that can be done in a four years' course. If we train our men in analytical chemistry, in general chemistry, and in such an amount of industrial chemistry as can be taught in the lecture room, and such an amount of laboratory practice as can be carried on in university laboratories, and at the same time give them their thermodynamics and physics, and a certain amount of mineralogy, I think that is the best we can do.

Professor A. A. Noyes.

In the first place I would say, I believe that a distinct demand by manufacturers for men trained in both chemistry and chemical engineering will make it much easier to induce students to take the extra fifth year that is necessary in order to do anything like justice to these two subjects. I believe, too, that institutions can do a great deal in this direction by laying out a definite course of fifth-year work, leading to some higher degree; for when a definite course is offered there are more likely to be applicants for it than if it is only stated in a general way that there is an opportunity for advanced work.

I should also like to ask the question, whether manufacturers prefer a chemical engineer or an engineering chemist—that is to say, a man whose education is mainly upon the mechanical engineering side, with some knowledge of chemistry included, or a man whose main training is in chemistry, this being supplemented only by such an amount of mechanical engineering as can be worked in without serious detriment to his chemical knowledge? I think it should be borne in mind in answering this question that, if the chemical engineer is preferred, it would certainly mean a sacrifice of the power of attacking new problems on the part of our industrial chemists. The engineer is trained to put in application existing methods; and it seems to me that what is wanted of the factory chemist in this country is rather the power of solving new problems and of making improvements in processes—a power to be acquired far more by a good chemical training, which should include a large proportion of research and other work requiring independent thinking, than by an engineering training.

In order to introduce any considerable amount of mechanical engineering in the chemical courses it is necessary to eliminate something that we have there now; and the question is a very pertinent one, What kind

of instruction can be best spared? By two of the speakers analytical chemistry has been emphasized as especially important, a subject to which already by far the larger part of the available time is devoted in most chemical courses. I myself consider it a question whether this can not be reduced to a considerable extent in the case of chemists preparing for positions in the works rather than the laboratory. Another question that may, perhaps, be worthy of consideration is whether the modern languages to which a very large amount of time is devoted in most of the college courses are actually made use of to any considerable extent by manufacturing chemists.

Professor H. P. Talbot.

We can not probably hope to transform the student into a chemist and an engineer in the same four years, but we can hope, I think, to turn out a good chemist—a man fundamentally trained, at any rate—and at the same time to give him so much of the fundamental principles of engineering that he will at least know what a mechanical engineer is talking about and know what he ought to be expected to do. That is a good deal in itself.

As to what shall be taken out of our chemistry courses to make a place for these other subjects, there must always be a certain amount of sincere difference of opinion. While analytical chemistry is the yard-stick by which the chemist generally measures his practical attainments, it is possible, I think, that we sometimes make a mistake in teaching analytical chemistry in a too abstract way. I am hopeful that, as time goes on, we shall be able so to arrange our courses that we can connect analytical chemistry in the mind of the student more closely with the scientific or industrial problems to which it is to be applied, and in this way can stimulate his interest and develop his ingenuity. If a change of this sort will produce a graduate with greater power to apply his knowledge and technique promptly and practically, the time spent upon analytical chemistry will be fully justified.

Dr. Wm. Jay Schieffelin.

I want to say a word in answer to the questions which Dr. Noyes has put—first, should less time be devoted to analytical work; and second, are the languages important?

Most of the industrial processes are elaborations or applications of methods used in analysis; therefore, the technical chemist should know the methods. It is very hard to-day to get a man who is a good analyst, upon whose analysis you can entirely rely. If he must make an analysis which he has not made before, he takes a book of selected methods and goes through it, but his results are not satisfactory. I think it is vitally important that the man should be a trained analyst. It is the hardest thing in the world to have a mineral accurately analyzed to-day and there are very few men in the country who can make an analysis of a new mineral from which its formula can be deduced. But what interests the chemist in the technical laboratory is improvement in processes and apparatus more than in minute accuracy of results; moreover, in any technical laboratory there are comparatively few varieties of analyses being made. It seems to me that the German language is immensely important, because the German works, Beilstein and Dammer, are to-day the chemist's bibles, and contain nearly everything on organic and inorganic chemistry which he wants to learn about, and they haven't their parallel in the English language. It is, therefore, very important to have a knowledge of the German language, and I do hope there will be no at-

tempt to reduce the amount of time given to quantitative analysis.

Dr. Hugo Schweitzer.

Until now we have been a happy family and I hate to sound the discordant note. I am absolutely against the introduction of chemical engineering in the education of chemists and want to restrict the same to pure chemistry. You have heard from Professor Chandler and from Professor Noyes and the other gentlemen who are teaching at our universities and colleges that it is impossible to make a chemist and a chemical engineer in four years. This is not to be wondered at, as Mr. Herreshoff stated in his paper, and it was this that struck me most, that chemical engineering embraces more kinds of engineering than any other branch of engineering. Now, since he, the most successful, the most ingenious, the most prominent chemical engineer in this country, has been able to master both sciences, he thinks that we average people of little brains and little minds should also succeed. Gentlemen, the proof of the pudding is in the eating. Let us be open and frank! What have American chemists originated in chemical manufacturing? You will find that we have been pioneers in only a very few instances. It is true we manufacture acids and alkali just as well and perhaps better than they do in Europe, but, as I say, we have been pioneers only in a few things, and the reason for it is in our method of education. Who asks that we should be both chemists and engineers? Do we chemists ask for it? No, we have trouble enough with chemistry. Do the teachers of chemistry ask for it? No, because they tell us to-night that it is impossible for them to convert their students into chemists and chemical engineers. You remember Dr. Noyes said that 'to-day chemical science requires as much detailed knowledge as did all sciences together fifty years ago.' Do you think that with such a broad field we can also master chemical engineering? Most decidedly not.

It is the manufacturer who asks that we should be both chemists and chemical engineers. In my opinion, the education of the chemist, gentlemen, is entirely a secondary question. As far as they are not educated chemically, it is the employers of chemists who need education. They engage a chemist, and paying him the generous salary which we chemists are wont to get, they think he ought to be a chemical engineer besides. What the manufacturers ought to do is: they should take the graduates from the universities as they are educated in pure chemistry and train them in their works at their expense during one or perhaps two years to become technical chemists and technical engineers. So, gentlemen, I urge upon you most sincerely to abandon the idea of educating chemists to be also chemical engineers, and now let us all work for the education of the chemical employer and the capitalist.

Mr. Maximilian Toch.

A student can study languages before he enters into his course of chemistry. German is essential, but French is not. When a student is admitted to college he is about seventeen years of age and he should then have a fundamental training in mathematics and languages; in fact, at the age of seventeen a student can be fairly well trained in elementary chemistry and in mathematics and drawing, so that the four years at college can be applied to chemistry, physics and electricity.

My suggestion would be that the colleges invite men to lecture who have been successful in manufacturing industries and they naturally can impart knowledge to students such as a professor is not expected to have.

The college laboratory is totally different from a factory. Any student can make an ounce of a material, but when it comes to multiplying that by three thousand technical education is necessary.

PROFESSOR M. T. BOGERT.

It appears to me that the employers of technical chemists really want two kinds of chemists. In the first place, they need what may be called technical directors; men who are trained more thoroughly on the mechanical side than on the chemical side; who understand the handling of both men and machinery and who know in a general way the chemical processes to be carried out; and secondly, scientifically educated chemists. The training of these two classes of chemists, it seems to me, is quite different. The man who has to do with a particular chemical problem and work it out in the laboratory needs a very thorough and highly specialized training in chemistry. Engineering is not necessary. The value of the results accomplished have been placed too much, in my opinion, to the credit of the technical director. The man who is working in the laboratory, the man behind the guns, is the man who has accomplished results in Germany as well as in this country. I think the progress in Germany in technical chemistry has been due largely to the work in the research laboratories by men who have no engineering training, and I plead with the employers for recognition of the work of the men in the laboratories and for greater patience in their dealings with them, and for a more enlightened policy in establishing research laboratories, for, in my opinion, it is only through such establishments that the American chemist can hope to compete with the German chemist.

MR. W. H. NICHOLS.

The young man who goes to college to get his technical training should determine whether he is going to use it in the realm of pure research or whether he is going to be a chemical engineer. The mechanical engineer can not take the place of the chemical engineer, as he goes to the other extreme. We have already the purely scientific chemist and the engineer; between the two we have the technical chemist or chemical engineer and there is plenty of opportunity for him.

It should be remembered in this connection that a college course is simply a foundation, on which the further education is to be built in after life; for it is not possible to furnish the thoroughly educated man in four or even in five years.

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## SCIENTIFIC BOOKS.

*Skew Frequency Curves in Biology and Statistics.* By J. C. KAPTEYN, ScD., Professor of Astronomy at Groningen. Published by the Astronomical Laboratory at Groningen. Groningen, P. Noordhoff. 1903.

This paper is almost unique in that it attempts to be at once a popular presentation of statistical methods and a mathematical derivation of a new theory regarding skew frequency curves, thus attempting to 'benefit all students of statistics' by his ideas. It is only necessary for the non-mathematical reader to take his mathematics for granted and apply the formulæ deduced, while the mathematician need not waste much time over the first ten paragraphs.

The author mentions how Francis Galton has shown that important biological conclusions may be derived from a discussion of the normal curve, and deplores the fact that most of these deductions can not be extended to the skew curves of Quételet and Pearson. This, he says, is due to the purely empirical nature of these curves; they furnish a mechanical representation of the data without having any real and vital relation to them. The advantages claimed for the new theory are: "(*a*) It assigns the connection between the form of the curves and the action of the causes to

which this form is due; (*b*) it enables one to reduce the consideration of any skew curve to that of the normal curve; (*c*) the simplicity of the application."

A popular discussion of the origin of normal curves follows. The curve, as is well known, is given by the expansion of $(1/2 + 1/2)^n$. Professor Pearson derives his skew curves by studying the expansion of $(p+q)^n$, where $p+q=1$. Now Professor Kapteyn considers the exponent $n$ as giving the number of causes which enter into the problem of growth, and shows that with a sufficiently large value for $n$, and natural causes must be looked upon as almost infinite in number, $(p+q)^n$ approximates closely to a normal curve or, quoting Bessel: "Whatever be the effect of the various causes of deviation, as long as they are: (*a*) very numerous; (*b*) independent of each other; (*c*) such that the effect of any one cause is small as compared with the effect of all such causes together, we shall obtain a curve which approximates the nearer to the normal curve the greater $n$ is."

But, though we may assume the effect of certain causes in producing deviations in certain quantities $x$ to be independent of the value of $x$, this can not be the case with quantities proportional to $x^2$, $1/x$, or any non-linear function of $x$. The resultant curves under these conditions are the skew curves. To obtain these the author supposes that 'on certain quantities $x$, which at starting are equal, there come to operate certain causes of deviation, the effect of which depends in a given way on the value of $x$.' Let us imagine certain other quantities depending on the quantities $x$ in the way given by $z=F(x)$.

Then we have

$$\Delta z = F'(x)\Delta x, \text{ or } \Delta x = \frac{\Delta z}{F'(x)},$$

where $\Delta z$ represents a series of deviations of the quantity $z$ independent of the value of $z$. Thus the effects of the causes of deviation operating on $x$ are proportional to $1/F'(x)$. Now since, according to assumption, the quantities $z$ are distributed in a normal curve, say

$$y = \frac{h}{\sqrt{\pi}} e^{-h^2(z-M)^2},$$

the quantities $x$ must be distributed along the curve

$$y = \frac{h}{\sqrt{\pi}} F'(x) e^{-h^2(F(x)-M)^2}.$$

This is the frequency curve generated under the influence of causes, the effect of which is proportional to $1/F'(x)$, no limits being placed as to the form of this function.

The author next takes up the case

$$F(x) = (x+\kappa)^q$$

the equation of the curve now being

$$y = \frac{Ahq}{\sqrt{\pi}} (x+\kappa)^{q-1} e^{-h^2[(x+\kappa)^q - M]^2},$$

and derives complete formulæ and tables for the finding of the five constants $A$, $h$, $M$, $q$, $\kappa$ for the five possible cases

$$q \gtreqless 0 \text{ and } q = \pm\infty.$$

The solution is left in a rather unsatisfactory state, as we can not find $A$ directly, while it is necessary to know $A$ in order to find the other constants. As $A$ is in most cases unity, he assumes this value for it, and computes the other constants. These having been found, $A$ is readily computed. If $A$ computed $\neq A$ assumed, try again with some other value for $A$ until a perfect agreement has been obtained. Another weakness of the solution is that only four of the observations of a set are used. These are so chosen that their abscissæ are in arithmetical progression. The author, however, considers this very fact an element of strength.

It can not be denied that Professor Kapteyn gets some very good results and his theory is undoubtedly full of possibilities.

C. C. Engberg.

The University of Nebraska.

*The Mammals of Pennsylvania and New Jersey.* A Biographic, Historic, and Descriptive Account of the Furred Animals of Land and Sea, both Living and Extinct, Known to have Existed in these States. By Samuel N. Rhoads. Illustrated with plates and a faunal map. Philadelphia, privately published. 1903. Pp. 252.

Mammalogists have been so busy in recent years describing, classifying and getting their

work on a sound systematic basis that few exhaustive studies of the mammals of limited areas have been made. The 'lay ornithologist' thrives throughout the United States. By his enthusiastic local work he has contributed largely to the present high state of knowledge of the birds of the whole country. Interest in mammals, however, has been lamentably slight, except among professional workers connected with museums. Mr. Rhoads's work on the mammals of Pennsylvania and New Jersey is a valuable object lesson for those who refrain from attempting local studies of mammals on the supposition that there are no opportunities for non-professional workers. The book, however, is not primarily non-professional, nor can Mr. Rhoads be called a 'layman,' but the amount of interesting and valuable data he has gathered in a comparatively limited region is very suggestive of what might be accomplished by local students elsewhere.

The book takes the form of a list, with each species fully treated under several subtitles, such as faunal distribution, distribution in Pennsylvania and New Jersey, records, habits and economic status, and description of species. In addition to the recent species and subspecies, which number 96, a list of 95 which occur in the fossil state is given, and also a brief hypothetical list. Introduced exotics are likewise enumerated. The large list of recent forms, which in many cases includes two or more related subspecies, is swelled by 18 species of whales and dolphins found off the coast of New Jersey.

Besides being an accurate list of all the mammals known to occur within the boundaries of Pennsylvania and New Jersey, the work is of importance and interest in its bearing upon the history and habits of many well-known mammals. The accounts of species now extinct in the two states, such as the wapiti, the bison and the beaver, are of especial interest. The notes on habits are entertainingly written and will be found interesting alike to the ordinary reader and to the professional naturalist. The author's own observations, which are stated to have covered a period of eleven years in the region, are freely given, but considerable quoted matter is also included. This is taken largely from correspondence with old residents of various parts of the region. The reliability of such sources is of course doubtful, but the notes are evidently given for what they are worth. In one case, after a quotation of several pages, the fact is brought out that the narrator 'was in the habit of making a good story of his exploits.' Nevertheless, such information is valuable, and this method almost the only one for obtaining an idea of conditions no longer existing. As far as possible, primitive conditions have been contrasted with those of the present, with particular reference to the influences of settlement and deforestation upon the existence and distribution of the native mammals. When these processes have progressed still further, the value of this work in carefully setting forth present conditions will doubtless be appreciated by future students. Distribution is usually stated in terms of life zones. A religious correspondence of the ranges of the mammals with the zones is implied throughout. Indeed, some subspecies are included solely because the zone they are supposed to inhabit is known to extend within the boundaries of the region. The extent to which such distributions are theoretical is not emphasized. In this connection there appears to have been an opportunity for a suggestive outline of desirable confirmatory work for the future.

The nomenclature and technical treatment throughout are according to the most recent knowledge and standards. In several instances names in common use by others are slightly changed, but it is to the author's credit that the reasons for so doing are always stated, even if they merely amount to personal opinion. In one case, to which my attention has been called, a name has been wrongly applied, that of a domestic animal, the so-called Belgian hare, which should be designated as *Lepus cuniculus,* not *Lepus europæus.* Questions of doubtful relationships are discussed in some cases, and in this connection occasional disparaging allusions to 'the hair splitters' occur, as if to lead the unsuspecting reader to the belief that the author abhors such.

The book is illustrated with nine full-page plates, chiefly photographs of specimens. A double-page colored map of the life zones of the two states is also given. Since this is the most detailed zonal map of the region yet published, and since it differs in some respects from previous inclusive maps of smaller scale, it is regrettable that more space was not devoted to discussion of life zones and especially to the boundaries as indicated on this new map. It is also unfortunate that the colors are not those which from repeated use on other maps have become associated with the several zones. As a piece of book-making, the work is not all that might be desired. The paper is rather poor and errors in typography are not infrequent. Minor shortcomings, however, may easily be overlooked in such a good and useful book. It is a thorough exposition of the knowledge, past and present, of the mammals of the two states, and may be safely ranked among our most important works on the mammals of eastern North America.

Wilfred H. Osgood.

## SCIENTIFIC JOURNALS AND ARTICLES.

The last number of *The Journal of Infectious Diseases* contains the following articles:

Alice Hamilton: 'The Toxic Action of Scarlatinal and Pneumonic Sera on Paramœcia.'

C. P. Clark and F. H. Batman: 'Pneumococcal Bronchiolitis (Capillary Bronchitis).'

E. H. Ruediger: 'Improved Technic of Agglutination Test in Typhoid Fever—The Use of Formalinized Cultures.'

Roger G. Perkins: 'Bacillus Mucosus Capsulatus: A Study of the Group and an Attempt at Classification of the Varieties Described.'

Mary C. Lincoln: 'Agglutination in the Group of Fluorescent Bacteria.'

Edward C. Rosenow: 'Studies in Pneumonia and Pneumococcus Infections.'

Joseph Louis Baer: 'Epidemic Gonorrheal Vulvo-Vaginitis in Young Girls.'

Earle B. Phelps: 'A Critical Study of the Methods in Current Use for the Determination of Free and Albuminoid Ammonia in Sewage.'

Wm. Royal Stokes: 'A Simple Test for Routine Detection of Colon Bacillus in Drinking Water.'

George A. Johnson: 'Isolation of Bacillus Coli Communis from the Alimentary Tract of Fish and the Significance Thereof.'

Charles Harrington: 'Sodium Sulphite: A Dangerous Food-Preservative.'

Stephen de M. Gage and George O. Adams: 'Studies of Media for the Quantitative Estimation of Bacteria in Water and Sewage.'

Announcement has been made of the initial numbers of a series of *Bulletins* on pathology from the laboratory of the Medical Department of the University of California, Berkeley, under the editorship of Dr. Alonzo E. Taylor, head of the Department of Pathology and director of the Hearst Laboratory in San Francisco.

## SOCIETIES AND ACADEMIES.

### THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

The regular meeting of the section was held on February 29 at the American Museum of Natural History in conjunction with the American Ethnological Society. The program was as follows:

*Ethnological Survey of the Pueblos of New Mexico and Arizona, during the Summer of 1903:* Mr. George H. Pepper.

Mr. Pepper first went to Española, and from there visited the pueblos of Santa Clara, San Ildefonso, Pojoaque, Nambe and Tesuque. One of the ceremonial dances at the pueblo of Santa Clara was witnessed. San Juan, Picoris and Tesuque next received attention. After this work was completed the Hopi region was visited, the time selected being the occasion of the Antelope and Snake dances at Walpi. In the pueblos of Hano, Sichomavi and Walpi, special attention was devoted to the work of the Hopi potters, particularly Nampayo of Hano, who is the only one living that has made a careful study of the old pigments and clays.

On the second mesa the pueblos of Mashongnavi and Shungopavi were visited, and the Snake Dance at Mashongnavi observed. Oraibi, the seventh of the Hopi pueblos, situated fifteen miles to the west of the second mesa, came next. During the stay in this pueblo the wonderful Flute ceremony was enacted. From the Hopi region the route taken

led to the pueblo of Laguna in the western part of New Mexico, and from there to Acoma, where the Fiesta de San Esteban was seen. While in the pueblo of Isleta the Fiesta de San Augustine took place.

Visits to the pueblos of Jemez, Zia, Santa Ana, Ranchitas de Santa Ana, Sandia, San Felipe, Santo Domingo, Cochiti and Zuñi completed the season's work, which included all of the twenty-six 'mother pueblos' now inhabited.

The subject of primitive pottery-making as represented in the various groups was carefully considered and the technique of each culture was investigated. Samples of the materials used in the manufacture of pottery were obtained, as well as representative forms of finished vessels from each pottery-making pueblo. Nearly one thousand negatives were made to supplement the field notes, and to enhance the value of the exhaustive card catalogue pertaining to southwestern ceramics, which is now in the course of preparation.

*Archeological Survey of the Interior of the State of Washington, during the Summer of 1903:* MR. HARLAN I. SMITH.

Archeological explorations of the Jesup North Pacific Expedition were carried on in 1897 by Mr. Smith in the Thompson and Fraser River valleys of Southern British Columbia, and in 1898–99 in the shell-heaps along the coasts of British Columbia and Washington. In continuance of the general archeological reconnoissance thus begun in the northwest, the Columbia Valley was chosen as the field for research during the field season of 1903.

It was thought that by working in the Yakima Valley the boundary between the culture of The Dalles and that of the Thompson River region might be determined. The material, however, discovered by the expedition seems to prove that the Yakima Valley was inhabited by people having a culture which previously had been unknown to science.

In the region were found numerous evidences of the close communication of the people of this culture with tribes of the Thompson River region. Underground house sites, tubular pipes, engraved detalium shells, a decoration consisting of a circle with a dot in it, and rock-slide sepulchres, each of a particular kind, were found to be peculiar to both regions.

A considerable amount of material of the same art as that found in the Dalles region was seen. It is clear that the people living in the Yakima valley had extensive dealings with the tribes both northward, as far as the Thompson valley, and southward, as far as The Dalles of the Columbia. In this connection it is interesting to note that the present Indians of the region travel even more extensively than would be necessary to distribute their artifacts this far. Much less evidence of contact between the prehistoric people of the coast of Washington and that of the Yakima valley was discovered. A pipe, however, was seen which is clearly of the art of the northwest coast. It was found far up the Toppenish River (one of the western tributaries of the Yakima).

From the Yakima Valley the expedition was transferred to the lower Cowlitz River for work down that stream and along the Columbia from Portland to its mouth, partly to determine whether or not a portion of the evidences of coast culture which were found in the Yakima valley had not come up the Cowlitz and down the Toppenish River, since the head waters of the Cowlitz and the Toppenish are near each other. In this region many specimens were secured. The main work, however, was done in the Yakima valley, where many photographs were taken, not only of archeological sites, but also of the country in general. Human remains, which are useful in determining the type of these old people, were also collected.

The most remarkable specimen secured was a piece of antler carved in human form. This was very thin, and when found it was nearly as soft as so much sawdust or moulder's sand pressed together tightly. Proper treatment has rendered the object quite hard and able to bear handling. It was found under the vertebræ of a child in a grave. The grave was of peculiar interest because, contrary to usual practice, the body had been enclosed in a rude box made by placing about it thin slabs of

stone, and the cist thus formed had been covered with jagged fragments of rock, over which earth was spread. This doll-like carving of antler is considered to be one of the finest pieces of prehistoric art ever found in northwestern America.

James E. Lough,
*Secretary.*

SECTION OF GEOLOGY AND MINERALOGY.

The Section of Geology and Mineralogy held its regular meeting January 18, 1904, with the chairman, Professor James F. Kemp, presiding. In the absence of the secretary, Dr. A. A. Julien was appointed secretary *pro tem,* and papers by Dr. Irving and Mr. Wilson, abstracts of which follow, were presented.

*Microscopic Structure and Origin of Certain Stylolitic Structures in Limestone:* J. D. Irving.

From an extended examination of stylolitic limestones collected in Indiana and Wyoming, mainly by Mr. M. L. Fuller and himself, the author has drawn the following conclusions regarding the origin of the peculiar structures:

1. They were initiated along a thin clay layer in limestone and have been produced by the interpenetration of the limestone material on either side of this clay seam.

2. They are entirely independent of the presence of fossils existing in the rock, for they occur equally in those portions of the rock where fossils are absent and where they are present.

3. They were not formed by metamorphic agencies, or by the weight of overlying strata, or by other causes which would tend to distort and crush the rock material.

4. They were produced by a cause which operated on the material of the rock while it was yet unconsolidated, and in a condition approximating that which obtained at the time of deposition.

5. They originated under great pressure, the rock material being sufficiently soft to allow the bending of individual stylolites, and yet potentially rigid, so that organisms were sharply sheared off while held in the soft matrix.

While the cause of the pressure and the manner in which it had operated to produce these structures has not been determined, the author suggests that their production may be the result of the hydrostatic pressure of the sea water lying above the deposits. In the instances examined stylolites are characteristic of marine deposits formed in water varying from 400 to 2,500 fathoms in depth. If sea water be taken to have an average specific gravity of 1.028, then a one-foot column of water exerts a hydraulic pressure of .434 lb. per sq. in. of area. This would give, for the depth stated, a hydrostatic pressure of from 1,041 to 6,408 lbs. per sq. in. Such a pressure as this, coupled with the soft unconsolidated nature of the rock at the time it might have been exerted, seems to fulfil better than any other the conditions demanded by the observed facts.

*Recent Journeys among Localities Noted for the Discovery of Remains of Prehistoric Man:* J. Howard Wilson.

The author discussed man in the earliest times before the Neolithic age and afterwards illustrated his paper by nearly forty views of some of the most famous rock shelters, caves and deposits of Europe which have furnished remains of paleolithic man, including also slides of the type implements and weapons from which have been derived the principal evidence of man's existence in Quaternary times.

The paper recited briefly the history of the subject, the first finds, especially the work of Boucher de Perthes, and the gradual development of the science of prehistoric archeology. Reference was made to some of the disputed evidence of man's existence in the Tertiary period, and then the subject of man's existence as early as the Second Glacial period was treated more at length, with a consideration of the climate and physical conditions which prevailed in paleolithic times.

The paper closed with an attempt at a realization of the great antiquity of paleolithic man as shown by the immense physical and geological changes which have taken place since he first made his undoubted appearance.

At the regular meeting, February 15, Vice-President James F. Kemp presiding, the secretary read a letter from Dr. J. G. Aguilera correcting a statement in one of the papers presented at the December meeting of the academy, as reported in Science, regarding the great Bacubirito meteorite of Mexico. Dr. Aguilera called attention to the fact that this meteorite was discovered in July, 1871, as was stated by A. del Castillo in 'Catalogue descriptif des Meteorites,' Paris, 1889. It was described by F. Sosa y Avila in *Minero Mexicano* in 1890, and afterward was visited by Signor Buelna as a commissioner of the Geological Institute of Mexico for the purpose of calculating the cost of transporting it to the City of Mexico. In connection with this expedition Buelna made several drawings and photographs of the great mass of iron. Through the Geological Institute Professor H. A. Ward received exact information as to the locality of the meteorite and then visited it, removing the earth from about it and making new photographs. Professor Ward's recent articles (1903) have drawn renewed attention to this enormous meteoric mass, but the credit of original discovery and description belongs to the Mexicans.

The program of the evening comprised two papers, abstracts of which follow:

*The Occlusion of Igneous Rock within Metamorphic Schists:* Dr. Alexis A. Julien.

The term 'inclusive' is commonly applied, by the petrographer, to ordinary dikes of igneous rock, surrounded by beds of sedimentary rocks or of crystalline schists, intersecting them or intervening between their foliation planes. But for similar masses cut loose from all connection with the underlying magmatic source, swallowed up within strata of crystalline schists, and experiencing all stages in the process of reaction and final absorption, during metamorphic change, another term seems to be called for, 'occlusion,' signifying shut or sealed up beyond escape. Although the word is borrowed from the physicist, this can produce no confusion when applied to petrographic phenomena. Occluded igneous rocks may belong to either the acid or the basic class, as illustrated respectively, on Manhattan Island, by the earlier intrusions of pegmatite, never found as intersecting dikes, and by the intercalated sheets of diorite-schist. Occlusion is usually attended by mechanical and chemical processes. The former consist of thinning or thickening of igneous masses caught between the folia of schists during orogenic movements into lenticular masses; the crumpling and corrugation of sheets, and even rolling into cylinders; and the forcing of the pasty masses along foliation planes, in the form of intercalated or 'secondary' dikes. The chemical processes usually consist of micaceous alteration and ultimate absorption by disintegration and dissemination through the surrounding country rock.

In discussing this paper, Professor Kemp spoke of the value of the interpretation to those who have studied the region.

*Outlines of the Continents in Tertiary Times:* Dr. W. D. Matthew.

The author presented a series of world-maps showing the hypothetical outlines of the continents during the Pleistocene, Pliocene, Miocene, Oligocene, later Eocene and at the opening of the Tertiary period, as contrasted with the modern conditions. The series was got up for use in the Hall of Fossil Mammals in the American Museum of Natural History, to illustrate the geographical distribution of different groups of mammals during the successive epochs of the Tertiary and Quaternary. It is intended to represent a somewhat conservative view of past changes in world geography, and is regarded as a working hypothesis, based on our present knowledge of geology, paleontology and zoology, especial consideration being given to the mammalian paleontology.

The former extension of the Antarctic continent, so as to join Australia with South America, is regarded as occurring at the end of the Cretaceous period and is represented in the first map of the series. The connection with South Africa is regarded as too problematic to place on the map. The Eocene map shows the extreme of Tertiary submergence of the continents which are represented as forming six isolated land masses. The

three northern continents are connected throughout the Oligocene, Miocene, Pliocene and Pleistocene, Africa being joined to them by the Miocene, South America by the Pliocene epoch. The Pleistocene map shows especially the simultaneous glaciation of both northern and southern regions, modified in the north by sinking of the old Arctic continent beneath the sea level.

The supposed ancient continents of Lemuria, Atlantis, the Brazil-African land bridge, etc., are regarded either as proposed on insufficient data or as being outside the limits of this series.

In general it has been found possible to consider the true ocean basins (limited by the 1,000-foot contour) as permanent throughout Tertiary time. The union of Antarctica with Australia and South America is an exception to this rule, but is based on a large amount of evidence. It appears probable also that the disturbed belt which stretches through central Europe to south-central Asia, and ends perhaps in the East Indian islands, has been, in part, raised from abyssal depths to an equally stupendous height above the sea, since the beginning of the Tertiary.

*Discussion.*—Professor Osborn emphasized the value of these maps as expressing working hypotheses for the use of students of vertebrate paleontology.

Dr. Julien called attention to the evidences of glaciation in South Africa as having a bearing upon the question of a previous existence of land masses farther south.

Edmund Otis Hovey,
*Secretary.*

ASTRONOMY, PHYSICS AND CHEMISTRY.

The regular meeting of the section was held on February 1 at the American Museum of Natural History.

The first paper of the evening was a biographical sketch of the late Dr. H. Carrington Bolton by Dr. D. S. Martin, which was read by Professor Crampton, the recording secretary of the academy, in the absence of Dr. Martin. The section then passed a resolution to the effect that Dr. Martin's address should be published in the *Annals* of the academy, together with a bibliography of Dr. Bolton's papers.

The second paper was entitled 'Researches as to the Identity of Lexell's Lost Comet of 1770 with the Periodic Comet of 1889, 1896 and 1903,' and was read by Professor Charles Lane Poor. This paper gave the result of a new investigation of the motion of the periodic comet of 1889, 1896 and 1903 (Brooks), dealing especially with the great changes in its orbit caused by the close approach to Jupiter in 1886. The comet has now been seen at three returns to perihelion and the many observations made allow of a most accurate determination of the present orbit on which to base the investigation. Attention was called to the supposed identity of this body with the lost comet of Lexell, 1770, which disappeared after passing close to Jupiter in 1779, and this question was discussed at length.

The next paper, entitled 'The Year's Work with Radium,' was read by Dr. George B. Pegram, and was the second of the series on 'Recent Progress in Physical Science.' Dr. Pegram gave a review of the most important experimental and theoretical advances made during the past year in the knowledge of radio-activity; especially the work of Rutherford and Soddy in formulating the atomic disintegration theory of radio-active change, the discovery of Curie in regard to the heating effect of radium, and the experiments of Ramsay and Soddy bearing on the question of the continuous production of helium in radium compounds. An apparatus was exhibited like that of Mr. Strutt, to show by the alternate charging and discharging of an electroscope the production of electric charges by radium. The charging of the gold leaf in the apparatus shown by Dr. Pegram took place in about one minute.

The next meeting of the Section of Astronomy, Physics and Chemistry was held on March 7 and was devoted to an address by Dr. S. A. Mitchell under the title 'Recent Progress in Astronomy,' the subject being 'The Results of the Observations of the Last Solar Eclipse.' Dr. Mitchell gave an interesting *résumé* of the results obtained by the

different expeditions which made observations in the island of Sumatra on May 18, 1901.

Charles C. Trowbridge,
*Secretary.*

THE CHEMICAL SOCIETY OF WASHINGTON.

The 149th regular meeting of the Washington Chemical Society was held on Thursday, March 10, at 8 P.M., in the Assembly Hall of the Cosmos Club.

The regular program for the evening was preceded by appropriate remarks and the presentation of resolutions (published on page 595 of this journal) upon the deaths of Mr. E. E. Ewell and Dr. E. A. de Schweinitz, both of whom were former officers of the Washington Chemical Society.

The first paper on the program, entitled 'Testing and Quality of Chemical Reagents,' was presented by Mr. Lyman F. Kebler.

The speaker first considered the subject from the point of view of the manufacturer who, on account of competition and the demands for lower priced material, often finds it necessary to send out inferior reagents designated as 'C. P.' with the tacit understanding that this abbreviation stands for something other than its generally accepted meaning. The speaker believed that the above condition of affairs could eventually be overcome by the establishment of standards of purity for all chemical reagents, and the agreement of chemists and consumers generally to insist upon receiving goods which are of the purity designated. Such a plan would tend to put all manufacturers on an equal footing and make it impossible for one firm to sell a lower grade of goods for the same price that another receives for better reagents.

A great deal of the trouble up to the present time was considered to be due to the fact that government chemists generally have not insisted on getting pure materials, and it has, therefore, been difficult for chemists connected with manufacturing establishments to maintain a high degree of purity, because it is frequently contended by dealers, that what is accepted by the government ought to be good enough for the individual. The speaker urged the necessity for all chemists standing together in the matter. A large number of specimens of reagents containing a greater or less amount of impurity were exhibited, and discussion on the subject was entered into by Messrs. Hillebrand, Voorhees, Tolman and Noyes.

The second paper on the program was presented by Mr. B. J. Howard, and was entitled 'Comparison of Tests for Turmeric in Mustard.'

Turmeric may be added to mustard either in the powdered or else as a form of extract. Though added as a powder, if it is subsequently made up into prepared mustard by heating with water or vinegar, or both, the condition for the purpose of analysis is the same as the case of an extract.

Five methods of testing were made, viz., (1) the alkali test, (2) the sulphuric acid test, (3) the diphenylamine test, (4) the boric-hydrochloric acid and (5) the boric-oxalic acid test. The last two are merely adaptations of the tests made use of for detecting borax or boric acid used in foods as preservatives. The boric-hydrochloric acid reagent is made up of about equal parts of a saturated aqueous solution of boric acid and an equal solution of strong hydrochloric acid.

For the detection of turmeric in the powdered form a thin film of the sample to be tested is spread upon a microscope slide with a few drops of the reagent and examined with a low power lens or reading glass. When the boric-hydrochloric acid is used the film is allowed to evaporate—the best results being obtained with spontaneous evaporation. With sulphuric acid, boric-hydrochloric acid, or diphenylamine one part of powdered turmeric to 20,000 of mustard is easily detected, and much more positively than with either of the other reagents. In using diphenylamine, however, care must be taken not to confuse the after color produced by the action of the reagent upon the mustard itself for that produced by the turmeric.

For the detection of turmeric in the extract form the method must be modified. The sample is mixed with three or four times its volume of 90 per cent. alcohol, and allowed

to stand for one or more hours, shaking from time to time. The solid particles are then allowed to settle and a portion of the supernatant liquid poured into a salt cellar. A wedge-shaped strip of filter paper is suspended so that the tip dips a short distance beneath the surface of the liquid. The liquid is drawn up into the paper, and as evaporation takes place the turmeric is concentrated in the filter paper for subsequent testing. After standing for a few hours the paper is tested by the boric-hydrochloric acid reagent upon a porcelain or glass plate. A pink or bright red color which turns blue when treated with ammonia indicates the presence of turmeric. Some anilin dyes used for coloring mustard give a similar red tint but are not turned blue with ammonia. If a few drops of the boric-hydrochloric acid are added to the test liquor in the salt-cellar before absorbing into the filter paper, the pink color shows up as the drying proceeds and thus sometimes lessens the time required in making the test.

The third paper on the program was presented by Mr. E. McKay Chace, and was entitled 'The Use of Basic Aluminium Acetate as a Preservative in Sausage.' Two samples of imported sausage were found to be preserved with aluminium salt to the extent of 200 milligrams to the pound can. The manufacturer of one of the samples admitted having used basic aluminium acetate in the proportion of one half of one per cent.

As aluminium does not occur in the animal organism a qualitative test is sufficient to detect its addition. The following test was used: Ash the sample, boil with strong HCl, add NaOH in excess, filter, make the filtrate acid and precipitate the aluminium with ammonia. The aluminium hydroxide and phosphate may be filtered off and tested on charcoal with cobalt nitrate.

For a quantitative determination the method of Wachenroder and Fresenius was used. (Fresenius, 'Quantitative Analysis,' 1904, Vol. 1, p. 459.)

It was found that aluminium formed a stable compound with the constituents of the sausage, which was insoluble in water, or HCl $N/10$ strength, but which was broken up on digestion with pepsin in .33 per cent. HCl, showing that the aluminium would be set free to retard the digestion in the stomach and intestines.

A. Seidell,
*Secretary.*

THE ONONDAGA ACADEMY OF SCIENCE.

At the January meeting of the Onondaga Academy of Science held in Syracuse, N. Y., the following officers were elected:

*President*—E. H. Kraus.
*Vice-President*—P. F. Schneider.
*Recording Secretary*—Albert M. Reese.
*Corresponding Secretary*—J. E. Kirkwood.
*Treasurer*—Miss L. W. Roberts.
*Librarian*—Mrs. L. L. Goodrich.
*Councilors to serve until 1907*—Mr. J. D. Wilson and Mrs. M. B. Ackerman.

The annual reports of the different sections follow:

*Zoology.*—Professor C. W. Hargitt. The section of zoology suffered an irreparable loss in the death of its chairman, Mr. H. W. Britcher, which occurred early in the year.

As a field naturalist he had few equals either among his associates in the academy or throughout the state. This will be measurably attested in the admirable check-list of the spiders of the county, which appears in the recent volume of the *Proceedings* and constitutes his final contribution to science, passing into type almost coincidently with the passing of his life. Other observations of like character are recorded in earlier contributions; notes on amphibia, reptilia and mammalia of the county appearing in the same volume. Would that his mantle might fall upon some worthy successor!

*Botany.*—L. Leonora Goodrich. The botanical class organized by certain members of the section has pursued a study of trees in winter which has proved very interesting. Of special interest, however, is the discovery of three plants new to this (Onondaga) county, one of which is new to the state. *Gaura biennis* was found among the limestone rocks near Belle Isle, and *Lythrum Salicaria* between Syracuse and Baldwinsville, about six miles from the city. In October *Phacelia dubia* was found growing on top of limestone rocks about eight miles south of Syracuse.

In this locality the plant was abundant and in bloom, notwithstanding the fact that its usual time of flowering is from April to June. This appears to be the farthest northern limit of this plant's occurrence and the only station thus far reported for it in this state.

*Geology*.—P. F. Schneider. The discovery is noted of two overthrust faults of small throw in the limestones of the Waterlime group, exposed by a cutting on the Jamesville suburban road. They are especially interesting because of the rarity of such occurrences in our horizontally stratified Paleozoic rock.

Several marked disturbances were also discovered in the limestones of the Helderberg series along the route of the Marcellus line and studied. A cave of considerable size was also opened up by the line of the Auburn interurban road.

Peculiar crystals of bright sparkling hematite have been found in the Red Shale of the Saline formation, especially in the lines of the cavities formed by the pseudomorphs after salt. These have been collected, described and studied. Crystals of celestite have also been discovered disseminated through one or more of the layers of the waterlime group in a recent railroad cutting near Jamesville. Some of the cavities are over half an inch in length and show the fauna of the celestite crystals perfectly preserved. More of the peculiarly clear and limpid quartz crystals have been found in the veins of the crystalline Onondaga limestone and described. Much additional information has also been added to our knowledge of local Pleistocene geology.

J. E. KIRKWOOD,
*Corresponding Secretary.*

THE ACADEMY OF SCIENCE AND ART OF PITTSBURG.
SECTION OF BIOLOGY.

THE monthly meeting of this section of the academy was held in the lecture hall of the Carnegie Institute, on January 5. Professor John C. Fettermann, biologist of the Western University of Pennsylvania, lectured on the 'Relation of Bacteria to the Dairying Industry.'

The lecturer brought out a number of facts concerning this very important industry. He discussed the nature of milk as it is secreted from the milk glands; the various bacteria commonly found in milk, and sources of contamination; the keeping qualities of milk, and the influence temperature has on the development of the bacteria; the different preservatives used to keep milk from souring, and their action on milk, and the injurious effect upon the consumer. Condition of milk as sold in large cities; the significance of the great numbers of bacteria present in normal milk; results of the bacteriological examination of normal milk, and the facts regarding sterilization and pasteurization; the use of pure cultures in butter making; the prevalence of particular bacteria in certain localities, by which means a peculiarly desirable flavor is imparted to the butter; the introduction of these bacteria into other localities, in order to produce butter of an equally good quality; the occurrence of bacteria in cheese, and their importance to the manufacturer.

A number of cultures in culture tubes were exhibited, showing the various stages of the development of the bacteria, and their effect on the milk. The method of making the cultures was also explained. The discussion following the lecture chiefly concerned tuberculosis and the danger of inoculation of human subjects by the use of milk coming from infected cattle.

Professor Fettermann stated that, unless the tuberculous stage involves the udder of the cow, there need be no cause for apprehension of inoculation of human subjects, and as this only occurs in about one per cent. of all cows infected with tuberculosis, the danger resulting from the use of such milk is insignificant.

Professor J. B. Hatcher exhibited before the section a molar tooth of *Mastodon* (*Tetralophodon*) brought from Burmah by Mr. J. F. Weller, of Emlenton, Pa. The specimen, which belongs to *M. latidens* or a closely related species, exhibits an interesting stage in the passage of the molar teeth of the Proboscidea from the conular type of the mastodons to that of the elephants, where the

enamel is arranged in numerous transverse laminæ.

FREDERIC S. WEBSTER,
*Secretary-Treasurer.*

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY GEOLOGICAL JOURNAL CLUB.

THE club has reviewed the following papers during the month of February:

W. G. Ball, 'The Outlook for Mining in the New Territory Opened up by the San Pedro, Los Angeles and Salt Lake Railroad' (*Eng. and Min. Jour.*, February 4, 1904); G. G. Wald, 'Comparison of Fatal Mining Accidents in the United States and Great Britain' (*Eng. and Min. Jour.*, January 14, 1904); L. T. Buell, J. T. Glidden, W. L. Spalding and E. Burton, 'Theories of Ore Deposition Historically Considered' (*Eng. and Min. Jour.*, December 14, 1903); G. F. Loughlin, 'The Differentiation of Rock Magmas' (*Eng. and Min. Jour*, October 17, November 28 and December 14, 1903). These papers were discussions by J. F. Kemp and Blamey Stevens, and the arguments were presented by Mr. Loughlin, with illustrations of occurrences of igneous rock in Massachusetts. R. H. Allen, 'The Production of the Minor Minerals in 1903' (*Eng and Min. Jour.*, January 14 and 21, 1904); J. Daniels, 'The Geology of the Kolas Gold Fields' (*Eng. and Min. Jour.*, February 11, 1904); B. L. Johnson, 'Native Gold Original in some Metamorphic Gneisses' (*Eng. and Min. Jour.*, February 4, 1904); S. Shapira, 'Mining in Korea' (*Eng. and Min. Jour.*, March 3, 1904); U. S. Whittemore, 'The Origin, Properties and Uses of Shale' (*The Michigan Miner*, November, 1899, to February, 1900).

The following original papers were presented:

H. W. Shimer, 'The Discussions of Questions Arising from the Interpretation of Faunas with Reference to Trilobite Mountain, Orange Co., N. Y. 'The paper was taken from the results of detailed study in the region, and dealt mainly with the determining of strata in the absence of definite fossil evidence. The complete results are now in process of publication. G. Richards, 'Experiences in Mining in Mexico.' Dr. C. H. Warren, 'Asbestus as a Fire-Proofing Material.' Experiments by Dr. Warren on chrysolite, the principal asbestus of commerce, showed that it lost its cohesive strength after being subjected to red heat from three to four minutes, and gave ground for the conclusion that, in cases of great fires, asbestus could, at the most, serve only to delay the progress of the flames for a few minutes.

G. F. LOUGHLIN,
*Secretary.*

THE CLEMSON COLLEGE SCIENCE CLUB.

THE club held its regular monthly meeting on Friday night, January 15, 1904.

Professor W. M. Riggs gave some facts and figures in regard to street railways, as compiled from reports of the last census. The figures were especially interesting as showing the small number of fatalities resulting from travel on street cars.

Professor H. Benton gave a communication entitled 'The Shipment of Fruits and Vegetables on a Commercial Scale.' The speaker explained in detail the different kinds of shipping cases used in practice and pointed out the defects and advantages of the different types. The methods used in packing and handling the various fruits and vegetables on some large gardens and orchards in Georgia were pointed out. The methods of packing the various fruits and vegetables were explained, special attention being paid to the cantaloupe. The construction and method of filling refrigerator cars were explained and the defects in the method of refrigeration, as used at present, were pointed out. Some of the improvements which have been proposed, namely, refrigeration by means of liquid air, etc., were mentioned. The effect of cold storage on fruit was shown by means of lantern slides. The whole paper was illustrated by a number of lantern slides.

Under the title of 'Some Leaf Mining Insects,' Professor Chas. E. Chambliss gave notes on *Bucculatrix pomifoliella, Aspidisca splendoriferella* and *Tischeria malifoliella*. The work and the stages in the development

of *Tischeria malifoliella* were illustrated by photographs and photomicrographs.

F. S. Shiver,
*Secretary*.

Clemson College, S. C.,
March, 1904.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

The academy held a regular meeting on March 7, Mr. Edwin Harrison presiding.

Dr. C. A. Snodgrass, city bacteriologist and pathologist, read a paper on the subject 'Bacteria and Their Work,' illustrated with drawings and cultures. He gave a clear conception of the place occupied by the bacteria in the living world, and the important work they were doing. He emphasized the fact that bacteria must not be confounded with disease. The following were some of the topics discussed: The distribution of bacteria on the globe; nitrogen fixation; changes in bacterial flora in milk supplies; the bacteria of the Illinois, Missouri and Mississippi Rivers; symbiosis; immunity; biological factors that affect bacteria; the relation of human and bovine tuberculosis, and various methods by which infection occurs.

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA.

The 153d meeting was held in the Physics Lecture Room, Tuesday evening, March 8. The following papers were presented:

Professor A. S. Wheeler: 'Mercerization.'

Professor I. H. Manning: 'The Work of the Digestive Glands.'

Professor Charles Baskerville: 'Kunzite, the New Gem; Its Unique Properties' (with demonstrations).

A. S. Wheeler,
*Recording Secretary*.

## DISCUSSION AND CORRESPONDENCE.

### DR. CASTLE AND THE DZIERZON THEORY.

In a recent number of Science (March 4, 1904), Dr. W. E. Castle offers some criticism of my paper entitled 'The Origin of Female and Worker Ants from the Eggs of Parthenogenetic Workers,' published in the same journal December 25, 1903. My paper was written for the purpose of calling attention to certain observations which go to show that worker ants can produce worker offspring, probably from unfertilized eggs. I indicated the possible bearings of such observations on current theories of sex, instinct and natural selection. Incidentally, I protested against the wording of the Dzierzon theory in such terms as to preclude further investigation of certain phenomena covered by it, against a premature extension of the theory to groups of social insects less perfectly known than the bees, and against its use in bolstering up other hypotheses.

Castle pleads guilty to having used terms like 'invariably' in formulating the Dzierzon theory, but tries to evade the point by remarking that 'it scarcely requires explicit statement here that *all* conclusions of inductive science must be so qualified,' that is, by using such expressions as 'so far as observed' instead of 'invariably,' 'always,' etc. It is difficult to see what Castle gains by this statement unless he wishes to imply that all the conclusions of inductive science are on the same dead level of probability—Dzierzon's theory, the circulation of the blood, the etiology of cancer, the rotation of the earth and what not.

After virtually admitting that I was justified in objecting to his formulation of the Dzierzon theory, Castle feels called upon to present the arguments in favor of that theory, all of which are well known to every tyro in zoology. The remarks prefacing Castle's disquisition show that he regards the Dzierzon theory as sufficiently and satisfactorily established, and any expression of doubt concerning some of its implications as certainly useless and possibly heretical or even malicious. He desires to 'join issue' with me 'sharply.' Although I am by no means opposed to the Dzierzon theory, I accept the challenge, both because I do not wish to disappoint Castle and because his presentation of my views amounts almost to misrepresentation.

Since its promulgation more than half a century ago, there has never been a time when the Dzierzon theory lacked opponents, both among the bee-keepers and among zoologists

and physiologists. That this is still the case is shown by von Buttel-Reepen's renewed defense of the theory within the past two months, that is, since my paper was published.* Of course, such opposition by no means proves that the theory is false, but it shows very clearly, nevertheless, that the phenomena to be explained must be extremely complicated and difficult of observation. And no one who has studied bees or other social insects can doubt the truth of this statement for a moment. Our knowledge of many of the honeybee's habits, so unique among animals, is based on inferences often very remote and derived from conditions difficult to control; and hence, from a strictly scientific standpoint, more or less insecure. It is impossible to observe these or any other social insects without a sense of powerlessness to ascertain just what is taking place in the life of the colony. We see the insects feeding and rearing their broods and regulating the number and character of the personnel of their colonies with a sure instinct analogous to the regenerative and regulatory phenomena manifested by the tissues of the individual organism, but all this takes place as if it were behind a veil. When we are still so profoundly ignorant of the exact way in which these wonderful creatures bring about the differences between the queen and the worker, that is, between two forms of the same sex, is it at all likely that we can pose as knowing how the sexes themselves are differentiated? And even if we accept the Dzierzon theory for the bees, are we justified in transferring it to other insects of which our knowledge is still less satisfactory? Even so confirmed an advocate of the Dzierzon theory as von Buttel-Reepen regards such an extension as inadmissible at the present time.†

Leuckart long ago stated that complete proof of the Dzierzon theory would be forthcoming only when we should have an accurate knowledge of the bee's egg. There are some, like Castle and von Buttel-Reepen, who believe that this knowledge has been supplied by the recent Freiburg researches carried out by Petrunkewitsch.* Knowing from experience the extreme difficulty of interpretation and the possibilities of error involved in a study of the polar bodies of the insect egg, I venture to dissent from this view and to regard the knowledge to which Leuckart referred as still in the lap of the gods. In support of this statement, I may briefly discuss one aspect of Petrunkewitsch's work, his contention that the reproductive organs of the drone develop from the second polar body of the egg. This fantastical conception, for which not a particle of evidence had ever been furnished by any animal, was suggested as a laboratory hypothesis by Weismann 'mit aller Reserve' to Petrunkewitsch while the latter was still working on his dissertation. The suggestion bore fruit in the 'Habilitationsschrift' as a truly miraculous example of Weismann's powers of prophesy. But to any one who is at all familiar with the developmental stages under discussion, Petrunkewitsch's figures suggest anything but what he attempts to prove. Even in his first paper there is no satisfactory evidence to show that the cells regarded as derivatives of the polar bodies in the figures on plate 4 are really such, and not dividing cleavage cells or possibly vitellophags. These stages are all separated by a great gap from those represented on plate 3. When we take up the second paper we wonder how anybody could regard the figures there presented as even an adumbration of proof that the testes of the drone are developed from the polar bodies. There is, in fact, every reason to suppose that what Petrunkewitsch calls 'Zellen, aus dem Richtungscopulationskern entstanden' in his Figs. 1, 2 and 3, are vitellophags with altered nuclei, such as are often seen in

* 'Entstehen die Drohnen aus befruchteten Eiern?' *Bienenwirthschaft. Centralbl.*, No. 3, ff., 1904, 28 pp.

† 'Die stammesgeschichtliche Entstehung des Bienenstaates,' etc., Leipzig, Georg Thieme, 1903, pp. xii, 1–138, 20 figs.

* 'Die Richtungskörper und ihr Schicksal im befruchteten und unbefruchteten Bienenei,' Inauguraldissertation, *Zool. Jahrb. Abth. f. Anat. u. Ont.*, 14. Bd., 4. Heft, 1901; 'Das Schicksal der Richtungskörper im Drohnenei.' Habilitationsschrift., *Zool. Jahrb. Abth. f. Anat. u. Ont.*, 17. Bd., 3. Heft, 1902.

the yolk of fertilized insect eggs (*Doryphora, e. g.*) coexisting with healthier vitellophags provided with more rotund nuclei. When we come to the polar body derivatives in his Figs. 3, 5, 6, 7 and 8, we recognize the well-known 'dorsal organ,' or remains of the serosa aggregating and preparing to pass into the yolk. Between these stages and that of his Fig. 10 with nearly completed mesenteron (which he derives from the mesoderm [*sic!*]) there is another big gap, and so far as the figures go, no demonstrable connection to show that the testes are really derived from such an absurdly improbable source as the 'dorsal organ,' to say nothing of the polar bodies. The only figures in Petrunkewitsch's paper showing unquestionable rudiments of the reproductive organs are Figs. 14, 15, 17, 18, 19 and 20, and in all of these the organs are depicted in the relatively late stages of development that have been figured repeatedly by other authors. Then note the startling migrations described for the drone's testes and their antecedent cells! The second polar body is at first on the anterior cephalic surface of the egg. The cell derivatives leave this surface and divide into two groups which migrate to the dorsocephalic region and there reunite. The mass thus formed then proceeds caudally along the mid-dorsal line just beneath the blastoderm till it enters the abdominal region, where it breaks up into cells, which migrate ventrally on either side as far as the mesoblastic somites, become entangled with these and are again carried dorsally to the position of the definitive testes. Was ever organ more bedeviled in its development? And what shall we say of the 'critical caution' not only of taking work of this kind seriously, but of using it for propping up at one of its weakest points a complicated theory of sex?* And if such work on the origin of the drone's testes can be made the basis of a 'Habilitationsschrift,' how implicit should be our faith in the same author's 'Inauguraldissertation'?

Having, as he supposes, established the Dzierzon theory beyond cavil, so far as it deals with the honey-bee, Castle next proceeds to consider the ants, after the fashion of the typical laboratory zoologist whose motto is 'all species look alike to me.' He finds it necessary to admonish me for deeming it 'even a probability' that workers may develop from the unfertilized eggs of workers. Had he taken the pains to read the observations of Reichenbach and Mrs. Comstock with care, or better still, had he acquired a first-hand acquaintance with the two insects mentioned by those authors, namely *Anergates atratulus* and *Lasius niger*, he would have seen that his criticism is really as feeble as it is captious. A more careful writer would have observed that Reichenbach is not a myrmecologist and that his remarks on *Anergates*, etc., were cited mainly on account of their psychological interest as showing the flurry into which a man is thrown on discovering a fact that conflicts with some formidable theory. *Anergates atratulus* is a rare, monotypic, parasitic ant, which has lost its worker caste and has wingless, pupa-like males. Obviously, in such a species there can be no nuptial flight, and mating would naturally take place in the nest. Since the worker caste is non-existent, Reichenbach's, and hence also Castle's, reference to this species, is really irrelevant. In regard to *Lasius niger* Castle asks: "Is there any reason for supposing that the ants captured [by Mrs. Comstock] had not previously been with males? * * * May we not reasonably exercise some 'critical caution' before with Wheeler we conclude it probable 'that worker ants can really produce other workers or even queens parthenogenetically'?" It is

* I allude to that salmagundi (*Bull. Mus. Comp. Zool.*, Vol. XL., No. 4) in which the *disjecta membra* of certain Darwinian, Weismannian and Mendelian theories concerning three such intricate subjects as heredity, sex and parthenogenesis, are stirred to the point of turbidity, garnished with a few accessory hypotheses, and served up in a pamphlet of thirty pages. As if such messes could be either palatable or digestible! Morgan has presented an excellent criticism of this theory ('Recent Theories in Regard to the Determination of Sex,' *Pop. Sci. Month.*, December, 1903). It turns out to be merely another case of the old fallacy of juggling the phenomenon to be explained—in this case, sex—back into the germcells and then pulling it out again *à la* Little Jack Horner, with the naïve assurance of having contributed something 'new' to science.

clear, in the first place, that Castle is himself not only lacking in 'critical caution,' but in consistency, when he asks such questions. Since he accepts the Dzierzon theory and proceeds to extend it to ants, he has no right to change the theory during the transfer. All adherents of this theory would agree in pronouncing fertilization of worker bees by drones an impossibility. They would contend that this had never been seen. Hence if the Dzierzon theory is to be extended to ants we should consistently make the same assumption. Nor would this be merely an assumption. All observations—in this case far more easily controlled than in the bees—go to show that worker ants do not mate with males. The case for *Lasius niger* is even stronger than in the bees on other grounds also. In this ant the differences in size and structure, both in the reproductive organs and in the soma, are vastly greater between the female and worker than they are between the queen and worker bee. No one, to my knowledge, has ever seen even a receptaculum seminis in a worker *Lasius,* though a very distinct vestige of this structure is present in the worker bee.* But even if the receptaculum were present, there is no reason to suppose that it would function any more than it does in the worker bee. This would have to be admitted, however, if we are to interpret Reichenbach's and Mrs. Comstock's observations in accordance with Castle's preconceived notions, for it is clear that in the case of the Reichenbach colony months must have elapsed between the death of the males each year and the laying of the eggs, and Mrs. Comstock mentions the rearing of 'at least three complete broods' of workers in the absence of males. From what we know of other ants we could hardly suppose a *Lasius* worker to function as Castle imagines possible unless it were either a true or an ergatoid queen. But no one has ever seen an ergatoid female *Lasius niger* though this insect is not only the most abundant of ants but the most abundant of animals over a large portion of Europe and North America. In this country it occurs in innumerable colonies from an altitude of 10,000 feet in the Rocky Mountains to the sands of the Atlantic seashore. I have myself collected and examined thousands of these ants without ever seeing anything that even approached an ergatoid female. Is it probable then that two lots of ants collected at random, like those of Reichenbach and Mrs. Comstock, should both contain fertilized ergatoid females indistinguishable externally from normal workers, especially when we consider the remarkable propensity of the workers of this and many other Formicidæ for laying unfertilized eggs? Which, then, is the more probable interpretation of Reichenbach's and Mrs. Comstock's observations? Assuredly that which I advanced in my former paper.

* Castle's familiarity with the conditions in the bee is well illustrated by his remark that 'dissections of egg-laying workers, which were made by Leuckart, revealed no seminal receptacle, hence the eggs of such animals can not have been fertilized.' The existence in worker bees both of a vestigial receptaculum and of accessory glands was pointed out by von Siebold more than sixty years ago. Moreover, Leuckart, as he later admitted, overlooked the receptacle in the dissections alluded to by Castle. A glance at the well-known Leuckart and Nitsche chart of the honey-bee, which can hardly be lacking in the Harvard laboratory, would have shown Castle a by no means insignificant receptacle in both the sterile and the egg-laying worker.

Since the publication of my paper Professor Forel has sent me a short article,* from which I take the following paragraph:

> Zur Erklärung des Polymorphismus der Ameisen hat man zunächst die Analogie der Bienen herbeigezogen, welche im Stande sind, in den ersten Larvaltagen, durch veränderte Ernährung und Vergrösserung der Zelle eine Arbeiterlarve in eine Weibchenlarve umzuwandeln. Ferner hat man nach Siebold stets angenommen, dass die Männchen aus unbefruchteten Eiern, die Weibchen und Arbeiter dagegen aus befruchteten Eiern stammen. Letzere Thatsache schien auch bei den Ameisen zu stimmen, indem ich selbst and dann auch Andere stets Männchen aus unbefruchteten Arbeitereiern erzogen hatten. *Doch haben die neuesten Untersuchungen Reichenbach's klipp und klar den Nachweis geliefert,*

* 'Ueber Polymorphismus und Variation bei den Ameisen,' *Zool. Jahrb. Suppl.* (*Weismann's Festschrift*), VII., 1904.

*dass aus unbefruchteten Arbeitereiern von Lasius niger Fabr. wiederum Arbeiter entstehen. Also wieder ein Dogma verfrühter Verallgemeinerung, dass in Nichts zerfliesst!**

Surely I may be permitted to express as a probability what the most eminent myrmecologist states in such emphatic language. That I was well aware of the remote possibilities mentioned by Castle, and of others which he does not seem to have surmised, is clear from my express statement that the observations of Tanner, Reichenbach and Mrs. Comstock are 'by no means final.' It would have been natural for a less captious critic to suppose that the views advanced in my paper were not determined solely by the observations cited from other authors, but to some extent by my own experiences, which though less tangible and less readily formulated at the present time, are not less suggestive to me of the trend of future investigation.

Academic convictions like those advanced by Castle can be of service only in prejudging a field of inquiry; they can be of no imaginable use in stimulating or furthering research except indirectly through the spirit of contradiction aroused by their dogmatic character. If Castle had any new facts, or original interpretations of old facts, for that matter, to bring to bear on the problems under discussion, I should be the first to welcome them. We need something more, however, than mere discussions of possibility and probability, if we are ever to dispel the mystery that envelops many of the instincts and reproductive processes in the social hymenoptera.

William Morton Wheeler.

American Museum of Natural History,
March 24, 1904.

* The italics are mine.

VEGETABLE BALLS.

To the Editor of Science: Can any of your readers refer me to any published mention or description (other than in Thoreau's 'Walden') of those balls of matted vegetable matter formed on the sandy bottoms of shallow ponds, apparently under the action of wave-motion? In what ponds or lakes (other than Flint's or Sandy Pond, in Lincoln, Mass.) are they known to occur? Have they any recognized names? Of what materials are they mainly composed other than *Eriocaulon* leaves? Any information will be very welcome.

W. F. Ganong.

Northampton, Mass.

## SPECIAL ARTICLES.

### RIGHT-EYEDNESS AND LEFT-EYEDNESS.

I wish to solicit the aid of the readers of Science in securing answers to the following questions concerning left-handed persons they may know:

1. Name, or at least initials, residence, sex, age and occupation?

2. Is the left-handedness complete or only for some of the acts usually performed with the right hand by right-handed persons?

3. Is the left-handedness the result of accident to the right hand or arm, or did it exist from infancy?

4. With which eye is a gun sighted, a board or yard-stick proved straight, or a table level, etc.?

5. With which eye, without glasses, is the vision of letters across a room in a good light the clearest? (Alternate covering either eye, not closing it.)

6. If glasses are worn for distant vision, the oculist's prescription, and the relative sharpness of vision of each eye with the glasses?

Right-handed persons are, I believe, naturally right-eyed, and the left-handed are left-eyed. There is little doubt as to the first, but I have found it difficult to get data concerning a sufficient number of the left-handed.

The fact of right-eyedness or left-eyedness has, it seems to me, much greater significance than the similar conditions pertaining to the hands, but, so far as I can learn, nobody has even thought of it, much less discussed its many suggestive implications. Indeed, I question if the right-handedness or left-handedness is not a simple result of the ocular one-sidedness which preexisted and made necessary the paramount use of the one or the other hand. Both conditions, moreover, seem to me probably the simple result of the usual location of the speech-center in the left-brain. I

see no reason so far for this left-side placing of the speech-center.

Precision in running, fighting, defense, manipulation, distant vision of enemies, signs, etc., would begin at least early in the history of human savages, and winning in the struggle for existence even so early would depend generally far more on accuracy and perfection of vision than of manual dexterity. I have not been able to conclude as to the existence of any degree of right-handedness or left-handedness or of right-eyedness or left-eyedness, in animals. Beavers and monkeys might possibly show the beginnings of differentiation. In all human beings, of any degree at least of civilization, both facts can be demonstrated. When civilization is present, the demonstration is apparent in the right-handedness of archers, and those using weapons of battle, and especially of gunners. All military regulations require the musket to be brought to the right shoulder in aiming and firing. These and many other right-handed uses and customs, of course, presuppose and make necessary right-eyedness. In mechanical occupations all tools are made for the right-handed. Locomotive engineers sit on the right-hand side of the engine; that this is because of right-eyedness is proved by the fact that the throttle is manipulated by the left hand, the other and the more expert and stronger one being unused during the 'run.' But, if right-eyed, the engineer can see the track and signals better from the right side of the boiler than from the left. The great mystery and the long-discussed problem of the varying usage of the drivers of wagons, carriages, etc., in passing on the right or left, will be explained, I suspect, by right-eyedness. That those afoot always pass to the right, even though the carriages in the same street pass to the left, is explained by the fact that the field of vision in front and the choice of directions are better under the circumstances than it would be with the right-eyed passing to the left. The danger of collision of vehicles makes passing to the left the preferable and safer plan.

When the harp grew into the dulcimer, and that into the piano, the execution of the most important, skilled and difficult part, the melody or air, was of course given to the right-hand side of the key-board, and the easier and accompanying part to the left. But prior to that was the violin, and it is only the theory of right-eyedness that can explain why the most difficult and rapid fingering was given to the more inexpert left hand, and the simpler and easier bowing to the more dextrous right. The advantage was unconsciously recognized and unconsciously applied which comes from the learner's greater ability to see the motions and positions of the fingers with the right eye when the fingering is done with the left hand. The left hand and the neck of the instrument in this position are seen at an angle, and, therefore, more correctly, than would be possible if the right hand were used for fingering and the neck of the violin placed directly in the line of the axis of vision of the right eye. In this case there would be the difficulty and doubt which results from the foreshortening or from looking along a line or surface nearly level with the eye.

The more expert hand in shooting a gun is used for the simple task of pulling the trigger, while the weaker and more awkward left is forced to do the all important tasks of supporting the gun and taking aim or directing the barrel upon the mark. The right eye compels also this reversal of what would otherwise be the natural and unconsciously preferred custom. In chopping, hoeing, shoveling, etc., the weaker left gives the force and direction of the blow, and the right only guides a little the end of the tool, and in general serves a subordinate function. In these occupations the angled axis of vision as in the violin is not necessary, and would even be a disadvantage. Looking downward, as in writing, the right does its work more accurately when straight below.

Any number of similar examples will come to mind of the influence of right-eyedness in every department or phase of our life, and the explanation of a multitude of incongruities and peculiarities observed or hitherto unsuspected will be brought to light. There is hardly any act or custom, personal or social,

that does not give evidences of the influence of right-eyedness.

One wonders if a new clearness will not be brought into neurology and psychology by a careful correlation of the suggestions which the theory offers. The unification and perfection of innervation and cerebration must be better if initiated and executed with the cerebral centers mainly upon one side of the brain, than if the unity is gained by means of the longer and more distant commissural fibers extending between the two sides of the brain. In the right-handed the speech center is in the left side of the brain, as is also the innervational motor center for the right hand, and the optical center of the right eye. The dependence of all motion upon a perfect correlation of vision and judgment needs only to be mentioned. That all intellect is psychologically the product of vision is less recognized, but is not less absolute truth. The right hand writes, possibly because the right eye looks down upon the writing more accurately than would the left; both depend upon the synchronous and closely interrelated guidance of the speech-making function. All three are in closer unity and contiguity than if either were in the opposite side of the skull. A gentleman acquaintance who is left-handed for most things has by training during youth developed the habitual use of the right hand for writing. When he plays billiards he takes aim two or three times as long as others, and makes from six to ten motions with the cue before giving the stroke. One feels that his correlation of vision, judgment and motion is much more difficult than with other players.

In the left-handed, as is well known, the speech center is in the right brain. Hence the left-handed are also left-eyed.

The pathologic presents itself when in the right-handed by heredity or habit, right-eyedness is prevented by a greater ametropia in the right, by accident, injury, cataract, leucoma or other disease which markedly lessens its visual acuity below that of the left. Right-eyedness, however, will persist with considerably greater acuity of the left eye. To be right-handed by heredity and habit, and at the same time left-eyed by disease, etc., brings a doubt and an awkwardness into every act. After a half-life of right-eyed correlations and habits to be suddenly made left-eyed, etc., by disease, accident, or by glasses produces something like tragedy in a patient. Many problems and ill-successes in the practising ophthalmologists' office receive an illuminating explanation by keeping in mind the physiologic fact of right-eyedness and the pathologic consequences of disease, or the result of interfering with it, by spectacle lenses. It may be better for the oculist to leave a person right-eyed rather than to give such lenses as suddenly compel left-eyedness.

For the present I will cite only three illustrative cases:

The first is that of a man who is left-handed in billiard playing and in most occupations. Asked to see if his cue was straight, he brought it before the nose with both eyes open, and thus 'sighted' along it. Asked to sight more accurately, he finally brought it opposite the right eye and closed his left. Asked to observe if two tables were exactly of the same height, he again sighted with the right eye, shutting the left. And he wrote with his right hand. These acts at first seemed to be incongruous, but they were all explained by the fact that his right arm had been broken when he was twelve years of age, and the right-handed acts since then performed with the left have been compelled because of permanent injury of the right arm. Writing being largely a finger-movement, and especially an intellectual act, was continued with the right hand. It has been demonstrated by pathology that the intellectual act of writing proves the location of the speech-center to be in the side of the brain opposite the hand used, although for all other usually right-handed acts the left may be preferred.

The second case is that of a carpenter who is left-handed, and has been so from infancy. He is also left-eyed. During his youth parents and teachers tried to make him right-handed by tying his left hand behind him, etc. As a carpenter he has to use tools, the plane, a vise, etc., made for the right-handed, but he is always awkward when thus com-

pelled to work. After planing a board thus held in a vise, he goes to the other end of it in order to sight down it with his left eye. With this eye he is an excellent judge of levels and straight lines. He steps off with the left foot first. The most remarkable thing about this case is that, although the man is a good hunter and 'an excellent shot,' he, from some unexplained reason, puts the butt of the rifle against his right shoulder. *But he does not sight with his right eye!* He leans his head sufficiently to bring the left eye in the line of the sights, and with this eye only he takes his aim. He chooses highly crooked or angled gun-stocks because of this necessity. The left-eyed, I suspect, will always be found to have some exceptional habits or vestiges of habits still unconquered by the outnumbering and preponderant right-handed ancestry.

The third case is that of a man who has been left-handed from infancy in the use of all instruments, knife and fork, billiard cue, gun, hoe, etc. But so much was he trained and forced to use the right hand in childhood and youth in writing with pen and ink that he now habitually writes with that hand, if using pen and ink. If using a pencil, chalk, etc., he is equally expert with the left and usually prefers it.

I gather that ambidexterity should be discouraged instead of stimulated. If a child prefers left-handedness, there will be a greater celerity and unity by means of the location of the three organs dominating action in one side of the brain.

I have never seen anything but bad results from the attempt to train children to use the right hand instead of the left, when there is a decided tendency or habit to be left-handed. Moreover the attempt is never successful. The best consequences are poor, and are only awkward mixtures of the two forms, which yield confusions and indecisions during the entire subsequent life. The instance of the billiard player of whom I have spoken is one. Another and more striking evil result is that of a naturally left-handed friend, A. V. P., who by arduous and continuous training during his childhood was compelled to write with his right hand. For all other acts he is left-handed but he can not use his left hand for writing. Although now past fifty he has always hated any writing, the mere act of doing so, and he can not do any original thinking while writing. He is for this purpose compelled to rely on a stenographer, and then his ideas flow freely and rapidly. If he tries to think, plan, or devise and to write at the same time there is a positive inhibition of thought and he must make sketches, epitomes, several efforts, copyings, etc., in a painful and most unsatisfactory manner. The attempt at ambidexterity has been a lifelong obstacle to him in his professional progress. The chief centers most closely interrelated in writing and thinking are thus demonstrably better harmonized when in one side of the brain. The mechanics of neurology are plainly less difficult than could be achieved by any foolish and unsuccessful ambidexterity.

As to the appearance of left-handed children of right-handed parents and ancestors, we are, of course, in no scientific stage to explain, any more than we can explain dextrocardia or other embryologic anomalies. Perhaps, as I have suggested, the location of the speech center in the right side of the brain, by some exceptional condition of development is the ultimate cause both of left-handedness and of left-eyedness. The problem of heredity of left-eyedness and right-eyedness would prove a most interesting study by the method of Mendel. George M. Gould.

Philadelphia, Pa.

## STUDENTS AT GERMAN UNIVERSITIES.

The following table, as reported by United States Consul Warner, Leipzig, Germany, shows the number of students attending twenty-one German universities during the winter semester, 1903–4, arranged in the order of their numerical importance:

For the present winter course the total number of matriculated students at the German universities is 37,854, of whom 3,093 are foreigners, the largest number ever recorded. The number of foreign students is equivalent to 8.2 per cent. of the total number.

| Name of University. | Matriculated. | Others Attending Lectures. | | Total. |
|---|---|---|---|---|
| | | Male. | Female. | |
| Berlin..... | 7,503 | 5,791 | 562 | 13,856 |
| Munich.... | 4,609 | 224 | 22 | 4,855 |
| Leipzig.... | 3,772 | 573 | 62 | 4,407 |
| Bonn...... | 2,294 | 103 | 87 | 2,484 |
| Breslau.... | 1,770 | 111 | 98 | 1,979 |
| Halle...... | 1,753 | 160 | 51 | 1,964 |
| Tübingen... | 1,387 | 26 | 3 | 1,416 |
| Göttingen.. | 1,370 | 51 | 57 | 1,478 |
| Heidelberg.. | 1,359 | 123 | 53 | 1,535 |
| Strassburg. | 1,333 | 96 | 71 | 1,500 |
| Freiburg... | 1,305 | 156 | 26 | 1,487 |
| Würzburg.. | 1,283 | 21 | 75 | 1,379 |
| Münster.... | 1,204 | 55 | ... | 1,259 |
| Marburg... | 1,154 | 74 | 18 | 1,246 |
| Giessen.... | 1,071 | 38 | 11 | 1,120 |
| Erlangen... | 982 | 21 | 10 | 1,013 |
| Königsberg. | 925 | 81 | 67 | 1,073 |
| Jena....... | 816 | 49 | 25 | 890 |
| Kiel....... | 758 | 41 | 15 | 814 |
| Griefswald. | 687 | 50 | ... | 737 |
| Rostock.... | 519 | 30 | ... | 549 |
| Total.... | 37,854 | 7,874 | 1,313 | 47,041 |

Consul-General Guenther, at Frankfort-am-Main, reports further that of these foreigners 739 are studying philosophy, philology or history; 722, medicine; 651, mathematics or natural sciences; 366, law; 231, political economy or forestry; 178, agriculture; 135, Evangelical theology; 32, Catholic theology; 26, dentistry and 13, pharmacy. Two thousand six hundred and twenty of them come from European and 473 from non-European countries. Among the former are 986 from Russia, 588 from Austria-Hungary, 318 from Switzerland, 162 from England, 73 from Bulgaria, 69 from Roumania, 64 from France, 59 from Greece, 55 from Servia, 49 from Holland, 41 from Turkey, 43 from Italy, 33 from Luxemburg, 33 from Sweden and Norway, 14 from Belgium, 13 from Spain, 12 from Denmark, 4 from Portugal, 2 from Montenegro and 1 from the principality of Lichtenstein.

Of the other foreign students, 319 are from America, 133 from Asia, 19 from Africa and 2 from Australia. The Americans are mainly from the United States and the Asiatics for the largest part from Japan.

These figures, however, include only the lawfully immatriculated students; to them must be added those who are enrolled as hospitants, of which 9,187 are reported in the foregoing table, including 7,874 male and 1,313 female attending as special students.

Noteworthy among other things, in the table above, is the numerical preeminence of attendance at Berlin, where the total exceeds that of Munich, Leipzig, Bonn and Breslau combined. But 42 per cent. of Berlin's attendance is made up of non-matriculated students, representing a floating element to a considerable extent. Elsewhere in Germany this feature is a minor one in university attendance.

Among non-matriculated students, one out of every seven is a woman, and over 42 per cent. of these women in attendance at the twenty universities are found at Berlin. Outside of Berlin women students among non-matriculants are best represented at Breslau, Bonn and Strassburg, but at none of these institutions does the attendance reach a hundred.

John Franklin Crowell.

Washington, D. C.

## *RESOLUTIONS OF THE CHEMICAL SOCIETY OF WASHINGTON IN MEMORY OF E. E. EWELL AND E. A. DE SCHWEINITZ.*

At the regular meeting of the Chemical Society of Washington, held in the Assembly Hall of the Cosmos Club on Thursday evening, March 10, 1904, the following memorial was presented by Dr. Harvey W. Wiley and, in accordance with the custom of the society, was ordered spread upon the minutes of the meeting, published in Science and a copy furnished the family of the deceased:

Mr. E. E. Ewell was a faithful and loyal member of the American Chemical Society and of the Washington Section thereof. At the time of his removal from Washington he was one of the vice-presidents of the section and in direct line to the presidency. For one so young his services to science were notable, and especially so in view of his willingness to engage in laborious routine work which occupied a great part of his time. His activities extended to all branches of agricultural and pharmaceutical chemistry. He organized in the Bureau of Chemistry the investigations of the qualities of the articles offered to the government under contract, and had charge of that part of the work committed to the bureau from the different departments of the govern-

ment. His personality was always agreeable and his friends were quite as devoted to him as those who were drawn to him by scientific ties. He was a manly man, honest, frank and straightforward in his conduct. He was always ready to take an active part in all the social festivities attending scientific reunions and was a welcome guest at a banquet or a smoker. His death removes from the field of scientific labor a faithful worker before he had reached his prime, while still full of promise made more sure by past achievements. As a man, as an investigator, as a coworker and as a friend we mourn his loss.

At the regular meeting of the Chemical Society of Washington held in the Assembly Hall of the Cosmos Club on Thursday evening, March 10, 1904, the following resolutions were presented by Dr. Marion Dorset and, in accordance with the custom of the society, were ordered spread upon the minutes of the meeting, published in SCIENCE and a copy furnished to the family of the deceased.

WHEREAS, We, the members of the Washington section of the American Chemical Society have heard with deep regret and profound sorrow of the sudden and unexpected death of Dr. E. A. de Schweinitz, be it

*Resolved*, That we hereby record this expression of our grief on account of the loss which we, his colleagues, have suffered, and which the scientific world at large has experienced through his untimely death. As a member and past president of this society he contributed in great measure to its success, and we feel that his death has removed not only a friend but a colaborer who has done much towards the advancement of his chosen profession; be it further

*Resolved*, That these resolutions be spread upon the minutes of this society and that a copy be furnished his family, to whom we extend our sincere sympathy in their bereavement.

Dr. H. W. Wiley, in seconding the resolutions, said: "Dr. de Schweinitz was first appointed in the Division of Chemistry on August 23, 1888. A full account of his service to science, a list of the papers he has published and his career in medical educational work are found in the proceedings of the memorial meeting held in his honor at Columbian University on Saturday evening, March 7.

"It is not necessary to recapitulate these proceedings here, as they will be published and made available to all his personal and scientific friends."

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## *DEPARTMENT OF INTERNATIONAL RESEARCH IN TERRESTRIAL MAGNETISM OF THE CARNEGIE INSTITUTION.*

THE Trustees of the Carnegie Institution at their annual meeting last December authorized the establishment of what is to be known as the 'Department of International Research in Terrestrial Magnetism.' An allotment of twenty thousand dollars ($20,000) was made with the expectation that, if the proposed work should be successfully organized, a similar sum would be granted annually for the period requisite to carry out the plan submitted by the writer, indorsed by leading investigators, and published in the Year Book No. 2 of the Carnegie Institution.

The undersigned has been appointed director of the department, and has been given full authority to organize it beginning with April 1, 1904. Arrangements have also been made so that the magnetic survey and magnetic observatories of the United States, conducted under the Coast and Geodetic Survey, remain in his charge, as heretofore.

The general aim of the work is 'to investigate such problems of world-wide interest as relate to the magnetic and electric condition of the earth and its atmosphere, not specifically the subject of inquiry of any one country, but of international concern and benefit.' The prime purpose, therefore, of this department, is not to *supplant* any existing organization, but rather to *supplement*, in the most effective manner possible, the work now being done, and to enter only upon such investigations as lie beyond the powers and scope of the countries and persons actively interested in terrestrial magnetism and atmospheric electricity.

At first principal stress will be laid upon the complete reduction, discussion and correlation of the existing observational data and upon early publication of the results in suitable form, in order to exhibit the present state of our knowledge. In this way will be revealed the gaps to be filled and the direction

of future and supplementary investigations will be suggested. While, however, this will constitute at first the chief work of the department, it is likewise proposed to embrace favorable opportunities for supplementing, by observation, the existing data and to cooperate with others in the observing of such of the earth's magnetic and electric phenomena as are of momentary occurrence, and the investigation of which is of great importance.

Details as to the method of work to be followed by the department and the investigations undertaken will be made known later. It is proposed that whenever feasible, those having certain pieces of work already in hand will be invited to associate themselves with the department.

A word of explanation as to the 'international' character of the undertaking. As all of the funds are supplied by the Carnegie Institution, it will not be possible to organize this department in accordance with the customs governing organizations the funds of which are contributed by various nations in concert, such, for example, as the International Geodetic Association, the International Catalogue of Scientific Literature, etc. While, however, the basis of organization can not be 'international' in the sense usually defined by such bodies, it is the intention to conduct the work with the counsel of an Advisory Board composed of representative persons, irrespective of country, and in this sense, the department is to be truly 'international.'

That an important step has been taken by the Carnegie Institution, will be patent to all who are interested in the development of our knowledge of the earth's magnetism and electricity. Professor Neumayer, one of the representative investigators who endorsed the undertaking and promised support, expressed himself thus when the project was submitted to the Carnegie Institution:

"I am of opinion that if this plan reaches its fulfilment, it is the most important step ever taken for the development of our knowledge of the earth's magnetism. The thought which underlies it must appeal to every one who has ever been engaged in geomagnetic investigations. In no other branch of geophysics is it more essential to extend the inquiries over the entire earth. Magnetic research, to be successful, requires the cooperation of the most competent investigators of all countries."

All mail intended for the department should be addressed as below. L. A. BAUER.

DEPARTMENT TERRESTRIAL MAGNETISM,
CARNEGIE INSTITUTION,
WASHINGTON, D. C.

## *SCIENTIFIC NOTES AND NEWS.*

PROFESSOR W. W. CAMPBELL has been elected one of the thirty foreign members of the Italian Society of Spectroscopists.

DR. W. J. HOLLAND, director of the Carnegie Museum, Pittsburg, has been made a corresponding member of the Swedish Society of Anthropology and Geography.

PROFESSOR EUGEN WARMING, of Copenhagen, has been elected a member of the Paris Academy of Sciences in the section of botany.

PROFESSOR L. LUCIANI, of Rome, and Professor A. Mosso, of Turin, the eminent physiologists, have been appointed senators of the realm in Italy.

MM. APPEL, Lenfant and Lebaume-Pluvinet have been elected members of the council of the French Astronomical Society.

DR. W. C. FARABEE, instructor in anthropology at Harvard University, is to conduct a party on an anthropological trip through the west, starting immediately after commencement.

PROFESSOR F. S. EARLE, assistant curator at the New York Botanical Garden, has gone to Cuba, on leave of absence, at the request of the Cuban Government, for the purpose of aiding that government in the establishment of a Department of Agriculture.

PROFESSOR ROBERT KOCH will return to Berlin at the end of June. He is at present at Dar-es-salaam, South Africa, studying malaria and the prevalent cattle disease.

A CHAPTER of the Scientific Society of the Sigma Xi has been established at the University of Illinois with Professor S. A. Forbes as president.

THE staff of the Henry Phipps Institute of Philadelphia, gave a dinner on March 28, at

which Dr. Lawrence F. Flick, director of the institute, was presented with a piece of silver plate.

Dr. M. Salomon has received the Alvarenga prize from the German Hufeland Society for his pamphlet on 'Tuberculosis as a Disease of the Masses and Measures to Prevent it.'

The municipal council of the City of Paris has presented M. and Mme. Curie with silver medals.

Mr. Arthur Thomson, assistant superintendent of the Gardens of the Zoological Society of London, has been presented with the society's silver medal for his services extending over thirty-four years.

Professor Cornil, of Paris, has been presented with a portrait and medallion on retiring from hospital service at the age limit of sixty-five years. Dr. Cornil remains professor of pathological anatomy in the University of Paris.

Dr. Wilhelm Hittorf, the eminent physicist and chemist, for many years professor at Münster, celebrated his eightieth birthday on March 27.

We learn from *Nature* that the Belgian Royal Academy has awarded its gold medal of 1,000 francs to M. Marc de Selys-Longchamps for his memoir on the development of a Pharonis. The Théophile Gluge prize for physiology has been awarded to Dr. P. Nolf, of the University of Liège.

Professor Wilhelm Ostwald will give at the Royal Institution, London, the Faraday lecture before the Chemical Society on April 19.

The Croonian lecture of the Royal Society was delivered on March 4, by Professor E. H. Starling, F.R.S., and Dr. W. M. Bayliss, F.R.S., the subject being 'The Chemical Regulation of the Secretory Process.' Professor E. Rutherford, of McGill University, will give in May the Bakerian lecture, on 'The succession of changes in radioactive substances.'

The following are among the lecture arrangements at the Royal Institution: Professor L. C. Miall, three lectures on 'The Transformations of Animals'; Mr. L. Fletcher, three on 'Meteorites'; Mr. H. F. Newall, two on the 'Solar Corona'; Professor Dewar, three on 'Dissociation'; and Sir W. Martin Conway, two on 'Spitzbergen in the Seventeenth Century.' The Friday evening meetings will be resumed on April 15, when Mgr. Count vay de Vaya and Luskod will deliver a discourse on 'Korea and the Koreans.'

Dr. Henry Milton Whelpley, professor of materia medica and pharmacy, Medical Department, Washington University, and of microscopy, St. Louis College of Pharmacy, delivered by invitation the valedictory address at the Pharmacy Department of Purdue University, on March 30.

A memorial has recently been erected to Max Schede in the grounds of the clinic at Bonn. The address was delivered by his successor, Professor Bier.

Mr. Henry L. Marindin, hydrographer connected with the United States Coast and Geodetic Survey since 1863 and a member of the Mississippi River Commission, has died at the age of sixty.

The death is also announced of M. Jules Garnier, known as a geologist and metallurgist, at the age of sixty-five years, and of Captain Deburaux, known for his aeronautical experiments at the age of forty years.

The A. W. Anthony collection of birds has been purchased by the Carnegie Museum, Pittsburg. The collection contains ten thousand specimens, including the types of all the species and subspecies described by Mr. Anthony. Mr. C. V. Hartman, the curator of archeology and ethnology in the museum, has removed the collection of Costa Rican antiquities made by Padre Jose Maria Velasco from the Archeological Department of the Free Museum of Science and Art in West Philadelphia to the Carnegie Museum at Pittsburg. This collection, together with another scarcely less important collection made by Padre Velasco, supplemented by the Troyo, the Ferraz and other collections recently acquired by the museum, give this institution the largest assemblage of Costa Rican antiquities in existence outside of Costa Rica. In fact, the Carnegie Museum possesses more

specimens of Costa Rican antiquities than are found in all the museums of the world put together.

AT a meeting held at the College of Physicians at Philadelphia on March 28, steps were taken to effect the organization of the United States Association for the Study of Tuberculosis, and Drs. E. L. Trudeau, George M. Sternberg, W. H. Welch, L. F. Flick and H. M. Biggs were appointed members of the committee. Dr. Wm. Osler was chosen chairman and Dr. H. Barton Jacobs, secretary for the committee, when it shall meet in connection with the American Medical Association at the annual session in June at Atlantic City.

THE American Neurological Association will hold its meeting at St. Louis on September 15, 16 and 17 immediately preceding the sessions of the various medical departments of the Congress of Arts and Sciences, beginning September 19.

OWING, it is said, to the war in the east, the Congress of Polish Scientific Men and Physicians will not meet at Lemberg this year, as has been announced.

A REUTER telegram from Vienna, dated March 19, states that at the request of the Academy of Science, the Austrian Minister of Agriculture, in order to facilitate the solution of certain important questions relating to the nature of radium, has ordered that from January 1 last until further notice no trading should be permitted in the residues from the manufacture of uranium colors at Joachimsthal, and that 10,000 kilograms of those residues should be reserved for purchase by the academy and another 10,000 kilograms for M. Curie, the discoverer of radium, in Paris. These consignments are to be devoted entirely to the purpose of scientific experiment.

M. DEUTSCH, having offered a prize of $25,000 for the first flying machine making a flight in a circle of one kilometer, M. Ernest Archdeacon has added a like sum and has appealed for further subscriptions.

THE electric railway at Nice having interfered with the magnetic observations of the observatory, suit was brought by M. Bischoffsheim, and damages have been awarded to the amount of about $20,000.

THE Civil Service Commission invites attention to the following named scientific and technical examinations to be held on April 19, 1904, with the statement that but few applications have been filed therefor:

Aid, Coast and Geodetic Survey.
Civil and electrical engineer.
Civil and electrical engineer, Philippine Service.
Civil engineer, Philippine Service.
Civil engineer and draftsman.
Architectural computer (Supervising Architect's Office).
Computer, Nautical Almanac Office.
Computer, Naval Observatory.
Deck officer, Coast and Geodetic Survey.
Topographical draftsman (Land Office Service).
Library assistant.
Manual training teacher.
Trained nurse, Philippine Service.

As the commission has experienced considerable difficulty in securing eligibles for the positions named, qualified persons are urged to enter the examination. Those who desire to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for a copy of the Manual of Examinations and the necessary forms of application.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

THE assembly has passed a bill appropriating $250,000 for the New York State College of Agriculture at Cornell University.

PRESIDENT C. E. MILLER, of Heidelberg University, Tiffin, Ohio, announced on March 24, that he had secured pledges to the amount of $150,000 for the fuller equipment of the university, $50,000 of this amount to be expended in buildings and $100,000 to be added to the permanent endowment.

A LADY, who has requested that her name be not made known, has given $40,000 for the erection of a dormitory for the women students at Colby College, Waterville, Me.

MR. ANDREW CARNEGIE has given $30,000 to Berea College in Kentucky. The trustees of the institution are preparing to test the constitutionality of the law recently passed forbidding coeducation of the races. It is also

reported in the newspapers that Mr. Carnegie has donated library buildings to Winthrop College, at Rock Hill, S. C., and to Converse College, at Spartanburg, S. C., both colleges for women.

The Court of Appeals has affirmed the judgment of the lower courts in deciding that New York University has no title to the lands or properties of the Loomis laboratory at 414 East Twenty-sixth Street. The laboratory was founded with $100,000, contributed by Dr. Alfred L. Loomis in 1887; its properties are now valued at $200,000.

The College of Pharmacy of the City of New York celebrated its seventy-fifth anniversary on March 29, by approving an agreement with the trustees of Columbia University whereby, after July 1, it becomes a part of the latter institution. Under the agreement the finances of the College of Pharmacy will remain in the control of its trustees, although the president of Columbia will be its ex-officio president. The present course of instruction will remain unchanged until the fall of 1905, when changes are to be made and approved by the officers of Columbia. The standard of admission to the College of Pharmacy, it is expected, will be raised. Students graduating as 'graduates of pharmacy' are not to receive the university degree, that being conferred only on doctors of pharmacy and post-graduates, who have passed the regents' examination.

It is expected that the new Agricultural Hall, now under construction at Clemson College at a cost of about $50,000, will be completed during the summer and ready for occupation by the opening of the next session. This building will provide class-rooms and laboratories for instruction in agriculture, horticulture, botany and bacteriology, zoology and entomology, veterinary science, and geology and mineralogy, besides a natural history museum. The state legislature, at its recent session, also established 124 agricultural scholarships at a value of $100 each.

The Oxford convocation has passed a decree accepting with gratitude a donation by Pandit Shyâmaji Krishnavarmá, M.A., of Balliol College, for the establishment of an endowment in memory of the late Herbert Spencer, the endowment to take the form of an annual lecture, with a provision that a 'Herbert Spencer' prize may, if desired, with the consent of the founder during his lifetime, be substituted for the lecture.

The trustees of Carleton College at Northfield, Minn., have appointed the Rev. Dr. George R. Montgomery, lecturer on philosophy at Yale University, to be professor of philosophy, *vice* the Rev. E. W. Lyman, who goes to the Congregational Theological Seminary at Montreal.

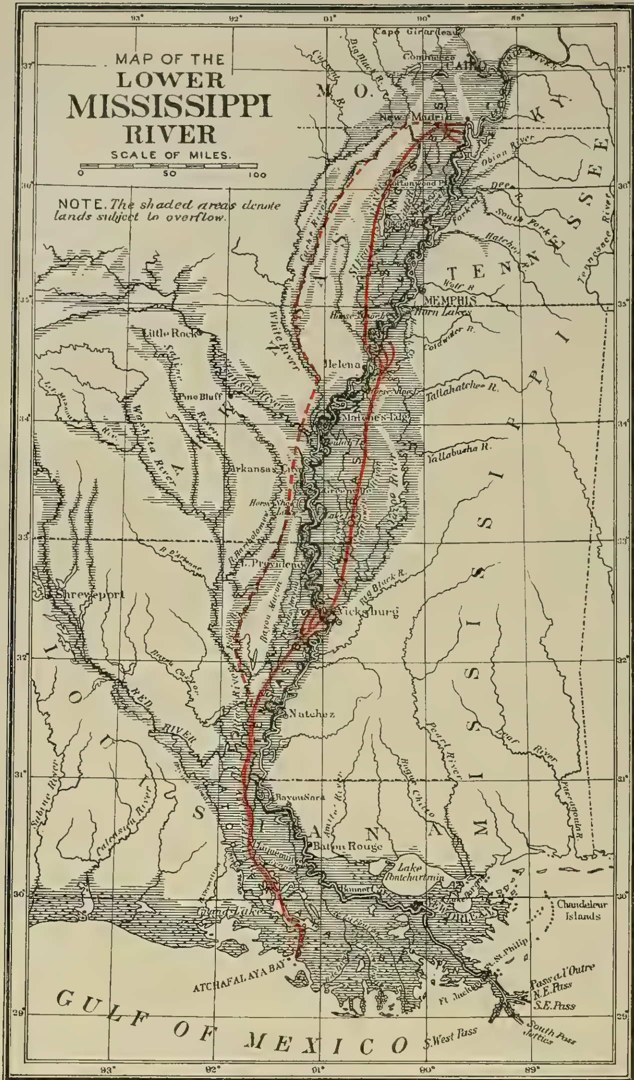
J. Volney Lewis, professor of geology and mineralogy in the Clemson Agricultural College of South Carolina, has resigned to accept a similar position in Rutgers College after the close of the present session.

Mr. J. E. Burbank, B.A. (Bowdoin), M.A. (Harvard), has resigned his instructorship in physics at the University of Maine, to accept a position in the Magnetic Survey, at Washington, D. C. Mr. L. E. Woodman, A.B. and A.M. (Dartmouth), formerly assistant in physics at Dartmouth, has been elected to the vacant instructorship.

The following appointments have been made at Harvard University: *Instructors*—O. Ames and J. M. Greenman in botany, A. B. Frizell in mathematics, J. A. Moyer in descriptive geometry, S. E. Whiting in electrical engineering, P. S. Smith in geology, and H. C. Boynton in metallurgy and metallography. *Assistants*—N. S. Bacon, L. S. Hapgood, P. H. Provandie, in hygiene; A. B. Plowman in botany, O. F. Black, J. F. Langmaid, A. D. Wyman in chemistry, and J. N. Bell in zoology. *Austin teaching fellows*—L. Ross in applied mechanics, A. H. Chivers in botany, A. Tyng in engineering, and A. E. Norton in mechanical drawing and mathematics.

Mr. Anthony Traill, M.D., LL.D., has been appointed provost of Trinity College, Dublin, in succession to the late Dr. George Salmon.

Kotaro Shimomura, a graduate of the Worcester Polytechnic Institute, has been elected president of Doshisha College, Kioto, Japan.


MAP OF THE
LOWER
MISSISSIPPI
RIVER
SCALE OF MILES.
0 50 100
NOTE. The shaded areas denote lands subject to overflow.
Cape Girardeau
Cairo
New Madrid
M O.
K Y.
T E N N E S S E E
MEMPHIS
Horn Lakes
Little Rock
Pine Bluff
Helena
White River
Tallahatchee R.
Yallabusha R.
Arkansas City
Providence
Shreveport
Vicksburg
Big Black R.
Natchez
RED RIVER
Pearl River
Bayou Sara
Baton Rouge
Lake Pontchartrain
Grand Lake
ATCHAFALAYA BAY
Chandeleur Islands
Pass a l'Outre
N.E. Pass
S.E. Pass
South Pass Jetties
S.West Pass
GULF OF MEXICO
M I S S I S S I P P I
L O U I S I A N A
Sabine River
Calcasieu River
Obion River
Wolf R.
Coldwater R.
Pascagoula R.

C W.Clark, Del

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 15, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *LEVEES, OUTLETS AND RESERVOIRS AS MEANS FOR PROTECTION AGAINST OVERFLOW OF THE ALLUVIAL LANDS OF THE MISSISSIPPI VALLEY BELOW CAIRO.*

THE alluvial valley of the Mississippi River below Cairo contains 29,790 square miles of land subject to overflow in its natural state. It is all capable of protection and reclamation by levees except a small area at the foot of each closed drainage basin, which must be left open for the escape of surface water, and a fringe of sea marsh along its southern border. It has been in course of progressive reclamation by that method for nearly two hundred years. For the last twenty years the United States government has been assisting in the work and its progress has been rapid. The existing lines of levee are about 1,350 miles long. About 80 miles remain to be constructed to complete in length the main river system, not including some areas so small that they are not worth the cost of reclamation at the present time. In only a few places, however, are the embankments as high and strong as they should be for the greatest safety. It is not known, in fact, just how high they ought to be in order to accomplish that purpose. The work of building them began at the lower part of the river and has been carried up stream progressively. As they advanced they confined within the channel more and more of the water of great floods which had previously escaped over the bank and made its way to the sea by other paths. This process raised the flood levels within the levees higher as they were extended up

stream, and they had to be raised and strengthened to meet the added load. These additions were made as the need of them developed. These needs were forecast from time to time as nearly as possible. It was a difficult problem. The 'potential high water' of floods to come has been the subject of much study and discussion. The nearest approach to a standard has been that the levee should be three feet above the highest previous flood line in that locality. In order to ascertain this line it has been the practice to record extreme high-water levels by marks on trees at intervals of a few miles along the bank. These records show such irregularity of behavior in the great floods as to make it necessary to fit the grades of the levee to local conditions. One element of disturbance and uncertainty yet remains in the completion of the closure of the St. Francis front, where about 60 miles of embankment remain to be built. That great basin, 6,700 square miles in area, has exercised in the past a profound influence on the channel along and below it. In its natural state it received a vast volume of overflow which it returned to the main stream again at and about the mouth of the St. Francis, immediately above Helena. This abstraction of water from the river along the upper and central portions of the front of that basin weakened the stream and so tended to shrink the channel in those parts; while its return at the foot of the basin augmented the stream, with a resulting tendency to enlarge the channel. Consequently, when we come to confine the flood discharge by levees along the St. Francis front, the water, in passing down, finds a channel of more ample dimensions in the neighborhood of the foot of the basin than that which it finds above. It is to be expected, therefore, that a great flood will reach a higher elevation in those parts of the channel where, for ages past, the flood volume has been depleted by overflow than in those parts where, during the same ages, the flood volume has been augmented by return of the overflow.

Still other circumstances enter in to complicate the problem, so that, upon the whole, only the actual confinement of a series of great floods without a break from Cairo to the sea will give us the ultimate high-water profile.

But we are making rapid progress toward that information. The great floods of 1897 and 1903 carried more water to the sea between banks than any of their predecessors. They have left records of gauge readings and discharge measurements which afford a great field of interesting study into which I can not enter within the time and space at my command. Those limitations will permit only the briefest summary of what the levees accomplished and what they failed to accomplish toward the protection of the lands behind them. They were floods of the first rank and may be taken as typical of what may be expected to occur at intervals of a few years in the future.

The flood of 1897 made 38 crevasses, having an aggregate width of about 8 miles; the flood of 1903 made 9 crevasses, having an aggregate width of about 3 miles. The levees in place in 1903, if no crevasses had breached them, would have protected about 26,000 square miles from overflow. Of that area a total of about 3,000 square miles was overflowed in consequence of the crevasses which took place, which is less than one eighth of the entire area which the existing levees could and would have protected if they had all been high enough and had held their places. In the phrase of the target shooters, they accomplished 87½ per cent. of success out of a possible 100.

These experiences indicate that with complete restraint of the floods by levees we shall have, as an immediate result, some further elevation of the maximum flood

level; but not very much—not enough to change any element of the problem, nor to introduce into it any new difficulty except the additional expense necessary to build and maintain the embankments at the higher grades required. The levees have done their work so well and are so far advanced toward completion that the abandonment of that system for an attempt to protect the alluvial lands in some other way is not to be considered for a moment. The interests involved are too vast to be put in jeopardy by experiment. To complete the existing system and maintain it is a duty so plain that it is not open to discussion. At the same time there is no reason why the believers in outlets and reservoirs should not continue to advocate their theories, nor why their arguments should not receive the compliment of polite refutation. There is still great lack of information on the subject in the public mind. The government has spent large sums from the United States treasury in aid of levee building, and must continue to do so if they are to be perfected and maintained; and all citizens who care to look into the subject are entitled to know why that method of protection has been and is to be pursued instead of others that are proposed.

Nothing could be more natural than the suggestion to seek relief from great floods by providing additional channels for the surplus water; and it takes some close consideration of the subject to perceive the fallacy of the proposal. But it is, as I shall attempt to show, a delusive scheme as a means of protection against overflow of general permanent practicability and utility. In the consideration of the subject I shall try to come a little nearer to it than has been heretofore attempted, so far as I know, by locating an outlet system on the only lines upon which it would be available for the advantage of the alluvial valley as a whole, and discussing its feasibility and utility from a practical standpoint. I have indicated such a system by the continuous red lines on the accompanying map. The broken red line is to be disregarded for the present.

Such a system would necessarily begin in the St. Francis basin. Suppose we should make a group of outlets near the head of that basin and connect them with a channel of sufficient capacity to carry, say, one tenth or one fifth of the combined discharge of the Ohio and the Upper Mississippi during great floods. The water thus diverted would be returned to the main channel at the foot of the basin, and would produce a flood height there as great as though the same water had come down the main channel. What should we do with it there?

A possible answer would be to make another outlet on the other side of the river into the head of the Yazoo basin, with a channel of like dimensions down that basin to its foot at the mouth of the Yazoo. To follow up the plan it would be necessary to make a third outlet, leading this time into the Tensas basin, with a channel leading down that basin across Red River and through the Atchafalaya basin to the gulf. We would then have two rivers from the head of the St. Francis basin to the sea, of which one would cross the other twice as a canal sometimes crosses a river in a pool raised by a dam. Those parts of the river in the neighborhood of the crossings would have to carry the whole flood volume and would require levees as high as, or higher than would be required in a levee system without outlets.

Such a combination would be enormously expensive. The secondary channel would be not less than five hundred miles long. In order to carry water enough to afford substantial relief from floods of the first magnitude it would need to be of large capacity. It would pass through the central parts of the fat alluvial basins. To dig

it, with all the use that could be made of existing streams and bayous, would require the removal of earth enough to build several times its length of levee. Nevertheless, with men and money and time enough it could be done. And if it were constructed, and in order at the oncoming of a great flood, I should suppose that for once it would materially lower the high-water elevation except in those parts of the river in the neighborhood of the crossings of the main river by the subsidiary channel. So far up and down stream as that engorgement extended it would be necessary to maintain levees high enough to take care of the water, to whatever stage it might go.

It would be the extreme of folly, however, to construct so costly a work without the assurance of its permanent utility. The probability of this result may be considered from two hypothetical points of view. From the first of them would be contemplated, I may say, a subsidiary channel sufficient in capacity to carry only a small part of an extreme flood—just the two or three feet on top which produce the greatest strain and danger under present conditions. Such an outlet opening would have to be very carefully constructed and guarded, in order to prevent its indefinite enlargement; but that could be done. For that purpose it would be desirable to take the water off through a number of small openings leading to the subsidiary channel as indicated on the map.

The extreme floods which this provision would be designed to relieve occur only rarely—not oftener, upon an average, than once in five years. During the intervals the unused channel, especially those parts of it not following the channel of some river or bayou, would be filled with a dense growth of vegetation—willows and cottonwoods, mostly. The floods have no regular periods of return, so that there would be no way to be sure that the channel would be unobstructed except to keep it open and clean all the time. This could be done too, but it would involve an annual expense equal to the cost of clearing a right of way for a railroad from Cairo to the gulf. It would be expected, I suppose, to lay out the subsidiary channel on comparatively straight lines down the interiors of the basins. This would result in a high velocity of flow in them; and this, again, would result in more or less cutting and caving of banks, with the consequent formation of bars. There would be danger that the subsidiary channel would follow the vicious example of its parent and overflow its banks; and to be secure against this danger it would probably be necessary to restrain its inherited propensities by levees.

It follows that, even with this smallest subsidiary channel that would suffice to relieve the tension of an extreme flood, we would have on our hands a work of prodigious magnitude and cost which, at its best, would relieve us of only a small part of our present burdens and dangers. It would be necessary to continue to maintain the levees on the main stream. They would be subject to the same accidents which befall them now. Caving banks would undermine them, and muskrats would burrow in them as now. Considerations of expense would require us to build on as low grades as would be consistent with safety, just as we do now. When a great flood came there would be the same apprehension of disaster, the same necessity for incessant watchfulness, and the same occasional crevasse which attend the floods now. Assuming that our outlets and subsidiary channel were entirely successful in accomplishing the work for which they were designed, we would still be little better off than we are now with the added burden of the enormous cost of the subsidiary system to be carried forever.

This, it is to be remembered, is upon the

assumption that the outlets would be designed to take from the main channel only the surplus of an extreme flood over the discharge of an ordinary flood. To consider the subject from the other point of view referred to, we may suppose the system of outlets and channels already described to be made of sufficient capacity to carry all the surplus water above the overflow stage, so that the levees on the main stream could be abandoned. This would require channels of far greater size and cost. But as the plan would propose to dispense with all levees and so save the cost of them, we may set off that saving against the cost for the present purpose, and confine our attention to questions of maintenance and effectiveness.

In such a system the subsidiary channel would be only another river. In all floods the two channels would divide the discharge between them, and water would flow in both of them all or a large part of the time. Would the river be able to maintain for itself as ample discharge room in the aggregate by a divided flow through two parallel channels as by a concentrated flow through a single channel? To state the question is to answer it. The smaller the channel *by* which a fluid flows the greater, relatively, is the retardation due to friction. A river flows with greater velocity at high stages than at low stages because of its greater volume. A flood divided between two channels would have less power to scour out and keep open the two channels than it would have to scour out and keep open a single channel. The two channels would have a greater tendency to fill up by deposit of sediment than a single channel carrying the whole discharge would have. There can be no dispute over these propositions among engineers.

It is by reason of the immutable operation of these laws that the Mississippi River has made for itself a single great channel from Cairo to the sea. As between two parallel streams produced by division the smaller stream is the weaker. As it shrinks in capacity by deposit, what it loses in volume of discharge the other stream gains. Thus the disparity between them in volume and energy increases at an increasing rate until the smaller channel is obliterated and the larger stream takes the whole discharge. To attempt to fight that tendency toward concentration in so great a river as the Mississippi flowing through a material so easy to erode and so ready to sink would be a futile undertaking.

I have thus discussed two imaginable outlet schemes—one a mere tapping, or bloodletting, operation to take off the top layer of an extreme flood, leaving the levees to take care of all the lesser floods; the other a true subdivision of flow complete enough to obviate the necessity of levees by providing sufficient channel capacity to carry all floods without overflow. It requires, as it appears to me, only a little close attention to the subject to make it apparent that they are both hopelessly impracticable.

In the consideration of the latter of the two plans stated—that one assuming a general abandonment of levees, and a reliance upon outlets and subsidiary channels as sole protection against floods, I have not taken into account the problems which would be presented at the intersections of the subsidiary channels and the main channel, because the argument seemed to me to be sufficient without considering them. I think, also, that it would be sufficient without considering anything but them.

Such an outlet scheme as I have supposed is the fairest one I can think of for illustration. It is not physically impossible. The soil of the alluvial valley can be fashioned in any shape you choose. There is an imaginable sum of money which would do the work. It would be a less violent contradiction of the natural course of

things than any other outlet scheme. The path of the subsidiary channel would lie wholly within the alluvial basin and over ground undoubtedly occupied in many changing locations by the stream, or parts of it, in bygone ages. It would be like what the river does now on a small scale in many places. At every 'chute' there is an outlet from the main stream and a subsidiary channel passing around an island and joining the main stream below. It may be one mile long or twenty-five. The island may be a mere 'towhead,' or it may be large enough to form a county. My subsidiary channels down the St. Francis and Yazoo basins would be only longer chutes.

Another scheme has been proposed, however, which I regard as more impracticable, if possible, than the one which I have described. It is to take an outlet channel across the upper end of the St. Francis basin through Crawley's ridge and thence to the gulf on a line lying wholly west of the Mississippi River. I have indicated one of its suggested locations by the broken red line on the map connecting the points at which it would leave and rejoin the subsidiary channel indicated by the continuous red line.

The first point to be noticed about such a plan is that it would cut off all the western confluents of the main stream below Cairo—the upper St. Francis, White, Arkansas, Black and Red. It would be an intercepting sewer for the southwestern quarter of the Mississippi valley. It would be a great big river. It would require an amount of excavation equal to several Panama canals, and levees nearly as great as those on the main river, in order to enable it to hold its own floods. Men have done a great deal in the way of improving the work of the Almighty in the creation of the earth already, but this would be a more extensive program of reconstruction than any before attempted.

The next point to be noted is that it would permanently lessen the volume of the main stream from the location of the outlet to the gulf. It would do this to the extent of the discharge of the intercepted tributaries plus the volume taken from the channel by the outlet. What that volume would be would depend upon whether the scheme contemplated a mere tapping process, to take off the upper few feet of extreme floods, leaving the levees to take care of all ordinary floods, or such large reduction of volume as would make the levees unnecessary. If the former, then, as I have already pointed out, we should still have 1,400 miles of levee to maintain at nearly the same cost and hazard which they impose upon us now, besides a second river to take care of, with all its vicious tendencies and caprices; if the latter, we would have two Mississippi rivers to be maintained in equilibrium against the forces of nature which tend constantly in such a situation to give to that channel which hath, and take away from that channel which hath not, even that which it hath.

Such schemes necessarily take a man far afield in the domain of speculation, but this much is certain; if it should prove to be impossible to divert enough water from the main stream in that way to prevent the overflow of the natural bank, the project would have failed as a means of protecting the alluvial lands from inundation; and, on the other hand, if such diversion should be found possible and be accomplished the depleted main stream would contract its channel to correspond with its lessened discharge. A river channel through an erosible formation always fits the river as a turtle's shell fits its back. There is no reason why the channel of the Lower Mississippi is larger than the channel of the

Missouri except that the former carries the greater quantity of water.

The immediate effect of permanently diminishing the volume of flow in the river would be to impair its value for navigation. This effect would follow quickly—within a very few years. A later effect would be to diminish the capacity of the channel to hold the floods, and so raise the flood heights. How rapidly this shrinkage would take place can not be stated; but it would begin at once and go on until the relations of volume and channel capacity found an adjustment in which the natural bank level would approximate the mean annual flood height. This would mean overflow in all floods above the mean.

The *modus operandi* of the filling up process is simple enough. The flood leaves high, vertical banks on the concave sides of the bends. The enfeebled stream at low water cuts into those banks at the base. The undermined earth falls down in great masses into the pool. The weak current is unable to carry it away, and so climbs up over it and goes on gnawing at the base of the bank. By this process it grades down the bank and fills up the pool to greater or less extent. This operation goes on during every low water in the Mississippi River now. Vast quantities of earth are knocked down into the pools by the undermining of the concave banks. But when the flood follows it digs that material out again and piles it up on the convex sides of the bends. One of the striking sights to be seen on going down the river at low water after a great flood is the immense bars piled high up above the low-water line by the preceding flood. The present channel is the result of nature's adjustment between this filling-up process and this digging-out process. If the activity and energy of the digging-out process were diminished the channel would fill up until the adjustment had been restored.

If the present discharge down the main stream were reduced by one half at all stages, the energy of the excavating force would be reduced out of all proportion to the reduction of the effectiveness of the filling-up force. The low-water current would eat away the base of the high banks and fill up the pools with material which the diminished flood would be unable to remove. The result would be at last a readjustment of forces with shallower pools, lower concave banks, less filling up, less digging out, less everything that pertains to the life of a river. Then when the great flood came it would find a diminished channel to carry it and would overflow the country as before. There would be less water to take care of and it may be that the floods could be restrained by levees of less height. As against that gain, however, we would have another river to take care of with its low water and high water, its bars, floods, overflows, levees, crevasses and other burdens and calamities. All in all, our last state would be worse than our first.

As for navigation, the present large schemes for ten feet or more from Cairo down would all go glimmering. The superb advantages which nature gave us in the one great river would be thrown away in exchange for two smaller rivers, more expensive to control, more destructive and less useful.

I have been discussing the feasibility of general protection of the alluvial valley from overflow by outlets. I have endeavored to take a practical view of the question by assuming definite plans with outlets and auxiliary channels definitely located. It seems to me that it is only necessary to approach the question in this direct and practical way to make it apparent that the outlet theory is a dream impossible of realization.

It does not follow from this that there is no situation in which no outlet of any kind

can have any utility. On the contrary, I think that there is a form of outlet which might possibly be employed upon the lower part of the river with advantage in conditions which may arise hereafter. Such outlets would be confined to points in the west bank below Red River. They would consist of regulated spillways, or waste-weirs, taking off the top layer of extraordinary floods and conducting the water to the sea across the Atchafalaya basin. Their object would be to alleviate extreme flood heights through the sugar country and at the city of New Orleans. They would have no effect upon floods in the central and upper parts of the valley. They would not be outlets, as the word is usually applied, but waste-weirs in the strict sense of the word—long, shallow notches in the top of the levee, stone paved and side walled to prevent the possibility of enlargement, with secure channels leading to gulf level in the Atchafalaya lakes and bayous. Their construction would be experimental both as to benefits in relieving the strain of great floods and as to their effect on the channel below them. I speak of them now for the sake, more than anything else, of forestalling any suggestion of inconsistency on my part in case the developments of a few years to come should indicate a need of them. I do not want to be tied to a word. The outlet theory is a delusion. At the same time, a safety valve in the form of an outlet might have a certain utility in a certain situation. This would not be as a substitute for a levee system, but as an adjunct to a completed and perfected levee system.

The time has not come yet for the practical consideration of such a scheme. We do not know enough to enable us to form a reliable judgment of the probable necessity and utility of it. We must hold a flood or series of floods so effectually that we shall be surer than we can be now of the elevations to be expected. It may cost us some dear experience—some bad breaks and disastrous overflows, but for the present nothing should be allowed to divert our money or our attention from the main work in hand—the full completion of the grand levee system of the main river. I have spoken of the possible utility of spill-ways, or waste-weir outlets, below Red River in order to mark with exactness that limited application of the outlet method which I believe to be feasible, and possibly useful, as distinguished from its general application, which I believe to be utterly impracticable.

On the subject of reservoirs little need be said. It is a delightful scheme to think of and talk about. It would beautify the map with lakes throughout the upper valley. It would bring the delights of boating, fishing and swimming within the reach of millions of us to whom they are now inaccessible pleasures. It would remove all danger of a surplus in the national treasury for a long time to come, and it might reduce the surplus in the Mississippi River somewhat.

When men think of reservoirs in this connection they commonly locate them in the headwaters of the Mississippi and the Missouri. Unfortunately, it is not there that the rains fall that furnish the stuff for great floods, but in the valley of the Ohio and its tributaries. The storms that sweep from the southwest across the Ozark Mountains and on over Kentucky, Illinois, Indiana, Ohio, western Pennsylvania, West Virginia and Tennessee are the bearers of woe to the people of the alluvial valley. One of the consequences of those rains has been to make the regions where they fall so fertile and attractive that they are filled with population, farms, cities, railroads, factories and all the adjuncts of high civilization. To occupy the country with the reservoirs necessary to hold back a great Mississippi flood would involve an incal-

culable destruction of property, to say nothing of the cost to build them.

There is one place where it would be possible, in an imaginative sense, to impound a volume of water that would be missed from the river. That place is the St. Francis basin, 6,700 square miles in area. By cutting that area up into subdivisions by dams crossing it at frequent intervals, and increasing in height progressively down stream as rapidly as the slope of the land surface would permit a vast storage of water could be secured, many feet deep at its lower border. But the only material that can be found there to make the dams of is earth. The expense of stone would be scarcely thinkable. And to imprison such a volume of water at the head of such a valley as would lie below it with only earthen walls to hold it back would be nothing less than criminal foolhardiness. The best use we can make of the reservoir theory is to keep it to talk about.

We frequently hear the present large projects for the storage of water for purposes of irrigating arid lands in the west spoken of as though valuable aid in the control of the floods of the Mississippi could be obtained from those works. For want of more accurate knowledge of the possible extent of that storage and its locality I can say no more than that while it may help a little, it appears to me that it can be no more than very little. It must be remembered that it would be of no advantage to the Mississippi River to diminish its volume at ordinary stages, or even ordinary flood stages. It is only by the power of its vast discharge that its great channel has been produced or can be maintained. A permanent reduction of its ordinary annual floods would tend to diminish its channel capacity. Better a great channel with a maximum discharge of 2,000,000 cubic feet per second than a less channel with three quarters of that volume, so the water can be kept within the banks. If the irrigation reservoirs should operate, as I fancy they would, to store a substantially uniform quantity of water each year and distribute it over cultivated lands, to be for the most part evaporated or absorbed, they would serve no useful purpose to the Mississippi except in rare and extreme floods, when it may be said that the smallest reduction is of some value.

All this emphasizes more and more the main truth that the present levee system has been so thoroughly tested, and has been of such incalculable value, and is so near completion, that it is a sort of treason to turn aside to talk about anything else for any other purpose than to illustrate by contrast the transcendent importance of finishing up what we have in hand.

Even this phrase needs definition. In a sense the levees of the Mississippi never will be finished. But they can be extended, raised and strengthened until they will hold the water even in such floods as that of last spring. At that period they will be 'finished' in the only sense in which it will ever be possible to apply that word to them.

It is not necessary, either, to the achievement of 'success' that they shall never be broken by crevasses. I have said that during the flood of 1903 the existing levees protected from overflow seven eighths of all the lands capable of protection by them if not one had failed. Suppose we should never be able to do better than that. Suppose great floods should come once in five years, and we should always save seven eighths of the land from overflow. That would mean that, upon the whole, taking all the years and the whole valley into account, there would be an average annual inundation of two and a half acres out of every hundred. I should call that success.

Robert S. Taylor.

Fort Wayne, Ind.

## *MUSEUMS AS PLACES OF POPULAR CULTURE.*

A CONFERENCE on this important subject took place at Mannheim, Germany, on September 21 and 22, having been convened by the Centralstelle für Arbeiter-Wohlfahrtseinrichtungen, an organization for social work that has its headquarters in Berlin. The meetings were held in the Aula of the city Realgymnasium, under the presidency of Dr. Schenkel, minister of the interior for Baden, and were attended by about two hundred people interested in this social question, of whom over fifty were practical museum officials, from all parts of Germany, with half a dozen from Switzerland, Austria and England. A philosophically ordered program had been drawn up some time beforehand, and was carried out with very slight modification. We take the following from a special report in the *Museums Journal*. The meeting on each day lasted from 9:30 A.M. till 4:30 P.M., with an hour's interval for lunch. Opportunities for social intercourse were abundant—at lunch, dinner and in the evenings; the museums and similar institutions of Mannheim and Heidelberg were thrown open to members, many of whom also visited the museums of Darmstadt, Mainz, Worms and other neighboring towns. Free seats were reserved for members at a special performance of 'The Merchant of Venice,' to which work-people were admitted for 40 pf.

The object of the conference was to discuss in what ways museums could bring themselves into touch with the working classes. The subject was introduced by Dr. Lichtwark, of Hamburg, who pointed out that modern museums differed from universities and academies in being open free to all classes; nevertheless, the very small proportion that the number of their visitors bore to that of the inhabitants showed that they needed to be made still more popular. Universal rules could not be laid down, but he foresaw a great revolution in the equipment and methods of museums, which would have to be brought into relation with men's daily life. The gradual change in the nature of museums was then traced by Dr. Jessen, of Berlin, who dealt with museums of fine and applied art, and by Dr. Lampert, of Stuttgart, who spoke of natural history museums. There followed what professed to be accounts of actual attempts made by various museums to render their treasures more useful to a wide public; but these tended to become simple descriptions of the museums. One gathered, however, that the Bremen city museum depended more on labels than on guide-books, that visits to it were obligatory on the school children, who afterwards were made to write essays on what they had seen, and that a reading-room and lecture-hall were connected with the museum. Dr. Lehmann explained how the exhibits of the Altona museum were devised so as to force their meaning on the dullest spectator, *e. g.*, two cases of the same assemblage of animals, one in summer, the other in winter; the popularity of the recently installed fishery exhibit showed how crowds could easily be interested in what really came home to them. A somewhat similar museum at Celle was described by Dr. Bomann. Professor Andreae advocated the use of photographs and their constant change, as at the Roemer Museum, Hildesheim; he thought that small museums should be many-sided. The description of the geological room at the Berlin museum, admirably arranged by Dr. Jaekel, showed that it was intended for students rather than the great public. Mr. Osthaus believed that a joy in art should and could be brought to the working classes, but the Folkwang Museum aimed at this by first influencing manufacturers and leaders of work through the exhibition

of the best art, and chiefly living modern art, in the most beautiful manner. Better to create art to-day than to be learned in the art of the past. Thus could art be pressed into the service of all. On behalf of Dr. A. B. Meyer, Dr. Wandollek described the efforts of the American museums in this direction, especially as regards children. The similar efforts of the school-museum at Hannover were detailed by Dr. Wehrhahn, who said that the small people found his simple rooms more attractive than the large museum palaces. An account of the Ruskin Museum in Sheffield had been distributed to members, and Mr. Gill Parker confined himself to showing a large series of lantern slides illustrating the activities of that institution. In the discussion on the above papers, Dr. Leisching, of Vienna, said that the Austrian government had established a circulating museum department, which sent art collections to towns that had no permanent museum, and arranged for lectures on these exhibitions by teachers at the high schools. Scepticism as to the value and possibility of the whole movement was manifest in the discursive speech of Dr. Lessing (Berlin), who maintained that the public as a whole, from the man in the street up to 'his Excellence'—and higher still, had not and could not be given a feeling for art, which term, however, seemed in the speaker's mind to signify chiefly ancient art and the old masters. A museum guide to art should be modeled on Huxley's 'Crayfish.' Dr. Pauli, of Bremen, was astonished to hear such retrograde views. No museum supposed that it could turn a road mender into a connoisseur on a Sunday morning, but it might be proud to have inspired only one or two per cent. of its visitors. The upper classes felt themselves above instruction, but working people were far more susceptible, and it was from them that future creative artists were to be expected.

The program of the second day, dealing as it did with limited questions of practical importance, gave rise to a more lively discussion. Dr. Lichtwark voiced those complaints about the architecture of museums with which we are familiar, objecting, among other things, to the corridor-like arrangement of rooms *en suite*, to the waste of space and money on a huge stair-hall, and especially to the domination of a whole museum by the architect's conception of his façade. As a small museum in which the architect and decorator had solved their special problem in a satisfactory manner, he instanced the Thorwaldsen Museum in Copenhagen. For appealing to the people of a large city, a number of small museums were better adapted than one large central museum. Dr. Jessen, emphasizing the point that museums should be built for the objects placed in them, maintained that the buildings should not be erected until a large amount of material had been collected, since not till then could one see precisely what was wanted. Professor Grosse, director of the art museum at Freiburg i. B. pointed out very clearly that one should not confuse the scientific study of art with the faculty of appreciating beautiful works of art, which latter was the need of the lay public. The collections for these two purposes should be separated. He, therefore, advocated the setting apart for the public of certain rooms, in which carefully selected objects should be displayed according to esthetic principles, abundance of space being allowed to each object, especially to the smaller ones. Different classes of objects should be intermingled, and the exhibits should be changed at intervals. Dr. Grosse was warmly applauded and his ideas were supported by several subsequent speakers, for instance, Dr. Schmid, of the Bavarian

National Museum, who also urged the value of small local museums for the encouragement of an art connected with the life of the people. Dr. Lehmann held that, so far as the public was concerned, the same principles were applicable to natural history museums. These ideas also found expression in a careful essay by Dr. Kautsch (Halle a. S.) on guides to, and lectures in, art-museums. The aim of these should be not to give a watered-down history of art, but to teach people to see; not to instil theories, but to evoke a conception of form; to create artists and artistic craftsmen, not to stifle the artistic faculty under the weight of learning that oppressed our so-called cultured classes. Professor Fraas, of Stuttgart, speaking of similar methods in natural history museums, gave the good advice that illustrations should be not pictures of specimens in the collection, but explanatory diagrams. His other remarks were much to the point, but the gist of them is familiar to our readers. In a detailed paper on temporary exhibitions in museums, Dr. Deneken, of Crefeld, inveighed against the superfluity of the usual class of exhibition, especially of art exhibitions, which had done the greatest harm to the development of art and were opposed to its true aims. Especially harmful were the permanent exhibitions of societies, with their commercial standpoint. For an exhibition to be useful, it should have a leading idea rigidly carried out; thus esthetic pleasure could carry with it artistic instruction. Even when the museum relied on its own resources there should be a selection of exhibited material on these lines and a constant change so as to keep up the public interest. This change would be helped by loan exhibitions, but here too the most careful selection must be enforced.

A speech from the minister of the interior and a vote of thanks to the town of Mannheim brought the proceedings to a close, and it only remains for us to mention an exhibition of various museum objects and methods that had been arranged, along with a collection of literature bearing on the subject.

In estimating the value of this congress, one must not look for immediate results in the rush of working folk to museums. Museums, as they now exist, are not suited to this new part they have to play. Fresh museums must be built, old ones adapted where possible, and, above all, new men to direct them must be trained. Any doubt as to the trend of events would have been dispelled by attendance at this congress; in such controversy as there was, the younger men were all on one side, and it is their views that are endorsed by the able critic of the *Kölnische Zeitung* (September 27). From a social point of view the outlook is encouraging, and the Berlin headquarters for the betterment of the workers may be congratulated. And as for museum men themselves, let us note that this is the first public conference of museum officials as such that has been held in Germany, probably on the continent. But, the first though it be, we find a remarkably large attendance, and including men of the highest official standing, while the whole is patronized by the government, presided over by a minister, and, last but not least, fully noticed in the press. Seeing how overdone with congresses they are in Germany, this bears witness to the skill with which the meeting was engineered. Whether it will give rise to further reunions, arranged by the museum officials themselves, remains to be seen; but this at least has been a gain, that it has brought together the mutually indifferent, not to say intolerant, science men and art men, and has shown them that they form allied branches of a great profession, working for one noble cause, and aiming at the same lofty mark.

## *SCIENTIFIC BOOKS.*

*Contributions to the Tertiary Fauna of Florida with especial reference to the Silex Beds of Tampa and the Pliocene of the Caloosahatchie River.* By WILLIAM HEALEY DALL, A.M. Transactions of the Wagner Free Institute of Science of Philadelphia, Vol. III., pp. 1654, 60 plates.

With the appearance of part VI. the Wagner Institute has brought to a close the work upon the Tertiary geology and paleontology of Florida begun in 1886, and recorded in Vol. I., and the series of volumes composing 'Vol. III.' of the *Transactions*. Vol. I. (1887) by Professor Angelo Heilprin, announcing the discovery of the Caloosahatchie Pliocene beds by Professor Heilprin and Mr. Joseph Willcox, with a first report on its fossils and those of the silex beds at Tampa, has already been noticed in these columns.

In 1890 the work was resumed by Professor Dall with the cooperation of the U. S. Geological Survey, originally with the intention of exploiting the Tampa silex beds (then called Old Miocene), the Chesapeake Miocene and the Caloosahatchie Pliocene. As the work progressed, these bounds were found too narrow for the full development of the subject, and practically all marine Tertiary faunas of America, from Panama to Canada, have supplied materials for the work. Even Cretaceous horizons have been laid under contribution. This spreading of the subject over faunas not indicated in the title of the work has provoked some adverse criticism not wholly undeserved, for it is undeniably a hardship to have new Cretaceous species described in a work on Neocene paleontology. But to the evolutionist, the student of molluscan genealogies, this wide range of comparison in a vertical direction, so to speak, is of inestimable value, and in the hands of Dall has brought out the relations of successive faunas in a way never attained by the old method of dealing with each formation separately.

Although the work deals only secondarily with stratigraphy, yet the collateral researches and field explorations undertaken in connection with the paleontological work give it high value from the purely geological standpoint. It marks an epoch in the study of eastern and middle American Tertiary deposits. The recognition and exposition of the marine Oligocene of Florida and the Antilles is one of the notable advances in geological knowledge. In the earlier part of the work it was recognized that the so-called Miocene of Florida comprised two very dissimilar faunas, and to the earlier the term Old Miocene was applied in this work. Further study and material showed that this 'Old Miocene' had nothing to do with the Miocene of the United States in its most typical development, as in Virginia and Maryland, but represented a group of horizons strictly analogous to those which had received from European geologists the name of Oligocene. These horizons contained a very rich warm-water fauna which was soon found to be more or less distinctly represented in the Tertiaries of middle America and the West Indian Islands." This led to the examination of the fauna of the beds at Bowden, Jamaica, and in Santo Domingo, etc., that the correlation of Antillean and continental beds might be discovered. "It was found that the connection between the Atlantic and Pacific faunas ceased at about the climax of the Oligocene, and that the relations between the faunas were so intimate that the Pacific coast forms could not safely be entirely neglected." These conditions gradually led to an extension of the work, in the course of which 'several distinct Oligocene faunas have been worked out with fulness and their relations established; a wide extension has been given to the Pliocene deposits, long confused with those of the Upper Miocene; the geological relationships of the beds between the Vicksburgian and the Pleistocene have been established in their main lines more clearly than has hitherto been the case.'

Regarding Antillean geology, Dr. Dall considers that the views of Professor R. T. Hill are supported by the evidence of Mr. T. W. Vaughan's field observations, and the information from other sources, as opposed to the hypotheses of Dr. J. W. Spencer, based upon his studies of submarine topography and of non-fossiliferous terranes supposed by Spencer to be marine Pliocene and Pleistocene. This

conclusion is not unexpected by those who have carefully examined the evidence, both geological and faunal. The data of zoogeography are wholly at variance with Spencer's hypotheses involving oscillations of gigantic vertical amplitude within late Neocene time.

To the paleontology Dall has brought to bear the experience of a life-long study of recent mollusca, an advantage possessed by few, if any other, writers upon American fossils. This has led naturally to a juster appreciation of the morphologic problems encountered than has been possible to most paleontologic authors, whose acquaintance with living mollusks is, as a rule, largely at second hand—from the manuals rather than the things themselves. With the great collection of recent American marine mollusks in the National Museum, the material for exact comparison of the fossil and existing forms was always at hand, and a vast number of corrections and rectifications of all sorts, in the nomenclature and classification of both recent and Tertiary mollusks have been made. This gives the work fully as much value to the student of existing faunas as to the paleontologist.

During the progress of the work a new classification of the bivalve mollusks (Pelecypoda) has been elaborated, a separate part being devoted to an exposition of the general system of pelecypods. Whether or not this classification will eventually supersede that of Pelseneer, which at present is generally adopted abroad, it possesses certain manifest advantages for the paleontologist over that of the Belgian zoologist, in that the hard parts, which alone are preserved as fossils, are taken into account. The work of Newmayr, the researches of Bernard and others upon the ontogeny of the bivalve hinge, and the phylogenetic studies of Dall himself, all indicate that the several elements of the hinge with its interlocking processes or 'teeth' are the biological expression of stresses to which they are subjected in the individual. The evolution of these wonderfully adapted structures has been in part worked out, so that the great part played by parallel or convergent evolution, hitherto hardly taken into account by paleontological students of bivalves, is now exposed, and sound phylogenies become possible.

Those who oppose the major divisions of Dall's classification will admit that the marshalling of the families into superfamily groups, and the internal analyses of these groups, has been accomplished with the consummate skill of a master.

In many groups of bivalves the classification down to genera and subgenera is worked out for all known forms, so that the work is a general manual of the subject, often with an entire recasting of the groups and their definitions, as in the Mactracea and Leptonacea (Parts IV. and V.). The treatment of the Veneracea and allied groups in Part VI. is equally elaborate, though less completely revolutionizing prior conceptions.

The matter of nomenclature has received great attention, and as a general rule the numerous changes of current usage have been made with excellent judgment. In some cases, such as that of *Pisidium,* it would seem that Dall has gone more than half way to meet trouble; while the emendation of some other names for the sake of Latin form will not be received with general enthusiasm. Thus if *Pitar* Römer (1857) is barred from acceptance because of its derivation from a West African tongue, it can not be used as a generic name in the form *Pitaria* (Römer) Dall (1902), because several other names were applied to members of the genus between these two dates, one of which would lead as a generic term. Here, as usual in such cases, it seems best to accept a generic name as it was coined, even if it is bad Latin. Little advantage or glory comes from breaking lances against such windmills.

An interesting and valuable point to the evolutionist is the persistence through long periods of characters apparently trivial—now a minute lamella or tubercle in the hinge, now an external sculpture-pattern or an internal sculpture, like the marginal grooving of *Transennella.* What we have looked upon as mere 'ornamentation' has often suffered the least change from age to age, and characterizes the successive members of phyla which in structures apparently far more important have

gone on evolving in parallel or divergent series. H. A. Pilsbry.

## SCIENTIFIC JOURNALS AND ARTICLES.

*The American Naturalist* for January contains the fourth of the series of papers on 'Adaptations to Aquatic, Arboreal, Fossorial and Cursorial Habits in Mammals,' the present being devoted to 'Cursorial Adaptations,' by Richard S. Lull. R. W. Shufeldt has a lengthy paper 'On the Osteology and Systematic Position of the Pygopodes,' giving at the end a comparison of the differential characters of the loons and grebes which are considered as forming two superfamilies. The affinities of these groups to the extinct *Hesperornis* are said to be practically certain, but this conclusion should be received with caution. T. A. Jaggar, Jr., renders a translation of the account of 'The Eruption of Mount Pelée, 1851,' from the French of Le Prieur, Peyraud and Rufz which is of considerable interest. The balance of the number is devoted to reviews and notes.

*The Popular Science Monthly* for April begins with an account of 'Recent Discoveries in Radiation and their Significance,' by R. A. Millikan, briefly summarizing our present knowledge of the subject and suggesting that certain elements, at least, are transmutable into others. 'The Evolution of the Human Form' is discussed by Charles Morris, who reaches the conclusion (somewhat open to question) that if there are beings on the other planets that answer to man they must follow his physical configuration. Solon I. Bailey describes 'The Arequipa Station of the Harvard Observatory' and Edward F. Williams presents his second paper on 'The Royal Prussian Academy of Science and the Fine Arts, Berlin.' Carl Duisberg considers 'The Influence of Liebig on the Development of Chemical Industries,' believing that while this is now great his indirect influence will be still greater in the future. J. Madison Taylor has the third article on 'The Conservation of Energy in Those of Advancing Years,' a general plea being for rational exercise and diet and not dependence on drugs. 'The Caucasian in Brazil' is considered by Thomas C. Dawson, who believes that he can hold his own in the tropics and adduces figures to show the greater fertility of the white race. Finally, Guy L. Hunner treats of 'The Air of the Luray Caverns.' The number contains the index to Vol. LXIV.

The April number of the *Transactions of the American Mathematical Society* contains the following papers:

G. A. Bliss: 'An Existence Theorem for a Differential Equation of the Second Order, with an Application to the Calculus of Variations.'

L. E. Dickson: 'Determination of all the Subgroups of the Known Simple Group of order 25920.'

C. N. Haskins: 'On the Invariants of Quadratic Differential Forms, II.'

E. D. Roe, Jr.: 'On the Coefficients in the Product of an Alternant and a Symmetric Function.'

F. N. Cole: 'The Groups of Order $p^3q^\beta$.'

Max Mason: 'Green's Theorem and Green's Functions for Certain Systems of Differential Equations.'

E. J. Wilczynski: 'Studies in the General Theory of Ruled Surfaces.'

## SOCIETIES AND ACADEMIES.

### THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 384th regular meeting of the society was held Saturday evening, March 19, 1904. Dr. C. E. Waters exhibited numerous specimens of common ferns in which the fronds were only partially fertile. The entire series demonstrated a complete gradation from the sterile to the fertile fronds. Dr. B. W. Evermann exhibited a series of seventy-three engravers' proofs of colored plates of Hawaiian fishes. All were drawn and colored from living fish, chiefly by A. H. Baldwin and C. B. Hudson. The live specimens were placed in an aquarium as soon as caught and the artist began work on them immediately or within a very short time. The result is an accurate reproduction of the actual life colors of the animals. The plates will be published in the near future by the U. S. Fish Commission.

Mr. W. P. Hay read a paper on the 'Life History and Economic Importance of the Blue Crab, *Callinectes sapidus*,' illustrating his remarks with lantern slide views. The more important life functions and habits of

the animal were described at some length. The process of casting the shell was detailed and several of the stages shown by photographs. Attention was called to the fact that the two forms of the female which have been described in this species are two conditions of the same individuals. One, with the narrow abdomen, is the original condition of the female, while the other, the form with the broad abdomen, is the condition assumed after union with a male preparatory to egg laying. It appears that eggs are not produced in water much less strongly salt than that of the open ocean. Consequently, egg-bearing females are seldom found in such bodies of water as Chesapeake and Delaware Bays, although crabs may be found in copulation there throughout the summer. The females probably die soon after spawning.

Under the title 'Natural Selection in Kinetic Evolution' O. F. Cook maintained that natural selection has a definite evolutionary function, not to be disregarded as under the theory of evolution by mutation. Selection is not, however, the direct cause of evolution; it is able to produce adaptations or accentuate particular characters by deflecting the normal evolutionary motion of species, which proceeds whether selection is operative or not. Selection represents, as it were, an obstruction in the evolutionary highway; the species is able to turn aside because it is normally in motion, not because the environment is able to initiate evolutionary changes in stationary organisms.*

Wilfred H. Osgood,
*Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

The 357th meeting was held March 8, 1904.

An interesting letter from Mr. C. H. Robinson, of Philadelphia, on certain ruins in Arizona, was read. Professor A. E. Jenks, of the Philippine Government, reports that he has secured living groups of the four principal peoples of the islands for exhibition at St. Louis. A letter from Dr. Daniel Folkmar detailing anthropological investigations carried on by him in the Philippines was read. Dr. Ales Hrdlicka announced the finding of cremated bones from Rockingham County and Scott County, Virginia, in the collection turned over from the Army Medical Museum to the National Museum.

The bill prepared by a committee of the society for the preservation of ancient ruins, and a resolution endorsing the same, were read. After a discussion by Dr. H. M. Baum and Mr. McGuire, the resolution was favorably acted on.

The general secretary exhibited a number of fire syringes from Burma, Siam and the Malay Archipelago, and demonstrated the efficiency of the apparatus for producing a spark. The range of the fire syringe was discussed, and it was suggested that the invention may have originated from the use of the popgun, or other air-compressing device. The paper was discussed by Mr. Safford and Dr. Hrdlicka.

Mr. W. E. Safford read a paper entitled 'Notes on the Language of the Aborigines of Guam.' The Chamorro-Spanish book on the Christian doctrine, written by an Augustinian friar, formed the basis of Mr. Safford's studies. The primitive words are of Malay origin, and not one per cent. are Philippine. The Guam language has affinities with the Papuan, as shown by the suffixed possessive particles. Mr. Safford discussed the spread of numerals, and says that complete data on this subject will go far to solve the problem of the origin of the Malayo-Polynesian and Papuan language. He called attention to the fact that the same system of numeration is spread from Formosa and the Malay Archipelago to Madagascar, and across the Pacific to Hawaii, New Zealand and Easter Island. A series of papers by Mr. Safford, embracing the grammar of the Guam vernacular, is appearing in the *American Anthropologist.* The paper was discussed by Dr. Lamb, Dr. Baum, Mr. Hallock and the secretary.

Mr. J. N. B. Hewitt read a paper entitled 'The Clan Among the North American Indians.' Mr. Hewitt said that among the Iroquois and most other tribes descent is on the female line. The clan is formed from

* For full discussion see *The Popular Science Monthly*, LXIV., pp. 445–456, March, 1904.

the coalescence of 'brood families or oachiras.' He detailed the rights and privileges of the oachiras and those of the clan which are more extended. Clan names are of some attribute of an animal rather than the name of the animal. In this connection Mr. Hewitt said that game animals were believed to be in duty bound to sustain man. The phratry was described as made up of several clans forming a unit for the celebration of festivals and ceremonies. The names of the Seneca clans with their meanings were given. The Iroquois League was organized like the clans by the rank or age of each unit giving a right to a certain place around the council fire. A very interesting branch of Mr. Hewitt's subject was the description of the method of transaction of business in council, when the matter under discussion was 'thrown across the fire' from side to side by the representatives of the different tribes. This valuable paper will appear in a forthcoming number of the *American Anthropologist*.

Walter Hough,
*General Secretary*.

THE NEW YORK ACADEMY OF SCIENCES.

SECTION OF GEOLOGY AND MINERALOGY.

A regular meeting of the section was held at the American Museum of Natural History, Monday evening, March 21, with the vice-president, Professor James F. Kemp, in the chair. Two papers were upon the program for reading. The first of these was by Mr. H. H. Wotherspoon, Jr., upon 'The Recent Advances in the Utilization of Peat and Lignite.'

The author said in part that the question as to the derivation of the fuel supply of the world is becoming more and more important. For years Europeans have been striving to devise a fuel to take the place of wood and coal. Recent advances in the price of coal in the United States have directed attention in this country along the same lines. In Europe, and particularly in Germany, many factories have been established for the compression of lignite, or brown coal, and peat into briquettes.

The principal deposits of lignite are near Berlin and Cologne. The larger of these is south and east of Berlin and is known as the Lausitz district. About 280 factories for the manufacture of briquetted fuel, with a total of 680 presses, have been established in these two regions, and their output in 1902 was approximately 12,438,000 metric tons. The briquettes are about 7 inches long, 2½ inches wide and 1½ inches thick, with rounded corners. Their wholesale price in the larger German cities is between $2.10 and $2.25 per metric ton.

Excellent briquettes have been made from the lignite of Alabama, but the experiments with the lignites of North Dakota have been less successful. The calorific value of the German briquettes is from 7,500 to 9,000 B.T.U.'s. True peat and other bog matter is becoming of importance in the manufacture of briquetted fuel. The process of manufacture which has been employed in Canada has depended upon heat for the expulsion of the major part of the contained moisture. This has been an unsatisfactory method, because the temperature (280° F.) necessarily employed has weakened the natural cementing qualities of the bog material.

The German method which has been very successful is to break up rapidly and thoroughly the cellular structure of the partly decomposed vegetable matter. This sets free the water from the plant fiber without injuring the cementing material. In the process part of the moisture is squeezed out of the mass, and the remainder evaporates rapidly on exposure to the air. The briquettes are ready to use in about two weeks after leaving the machine. Their calorific value is greater than that of the briquettes made from lignite.

The briquettes made from American bog matter seem to be as good as the European. The percentage of ash is high, but the ash is very free in character. This characteristic, together with the absence of sulphur, makes the fuel work well under boilers. Wherever transportation charges bring the cost of coal up to seven or eight dollars a ton, it is advisable for Americans to investigate the matter of utilizing neighboring bogs as a source of fuel supply.

Mr. Wotherspoon's paper was illustrated by a series of briquettes manufactured from European and American lignites and peats. He also exhibited a machine by means of which he manufactured in the presence of the section briquettes from peat which originated in Danbury, Conn. The paper was actively discussed, and many questions bearing upon the economic features brought forward by the author were asked.

The second paper of the evening was by Dr. Charles P. Berkey, of Columbia University, and was entitled 'A Geological Reconnoissance of the Uintah Reservation, southeastern Utah.' The author said in abstract:

Observations made in connection with other lines of work last summer have shown an erosion unconformity in the Carboniferous strata of the western Uintahs. It is marked on the south side of the range by an unevenness in the floor and a development of a conglomerate the pebbles of which are of the preceding formation. The break comes just above the chief limestone member of the series.

The junction between the great basal quartzite of the United States and the overlying strata is marked by a fault in this region with sufficient throw to bring two quartzite beds together on the higher plateaus and be easily overlooked. This makes it impossible to confirm Powell's unconformity at the top of the quartzite as described by him in the eastern Uintahs.

The discovery, however, of the Carboniferous erosion interval a little higher in the series throws additional doubt upon the assumed Carboniferous age of the great quartzite member. Allowing the breaking to cut out a part of the 'Wasatch' limestone and the 'Weber' quartzite, as developed in the Wasatch uplift, the lithologic succession is satisfied better by assuming Cambrian age for the lowest member in the Uintahs.

There is no other break to the close of the Cretaceous. A progressive unconformity, which increases in value against the flanks of the range, marks the development of Tertiary sediments in the Duchesne Valley. A conglomerate formed in progressive overlap from the stream valleys to the higher mountain tops of the flanks, has peculiar characters near the limestone belt, on account of which King called it 'Wyoming' conglomerate. These characters are too local to give it the assumed stratigraphic importance, while the flanking conglomerates are really of great range.

Edmund Otis Hovey,
*Secretary*.

THE AMERICAN CHEMICAL SOCIETY.
NEW YORK SECTION.

At the meeting held March 11 at the Chemists' Club, 108 West 55th Street, the program was as follows:

*Derivatives of Ortho-Methoxy-Benzylidene Acetophenone:* F. J. Pond and J. V. R. Evans.

The authors describe the preparation of o-methoxy-benzylidene acetophenone and of its di- and tri-bromides. The action of methyl and ethyl alcohols and of sodium alcoholate upon the two bromides is compared with the action of the same reagents upon the bromine derivatives of p-methoxy-benzylidene acetophenone. In the latter case, the alcoholate removes one atom of bromine with substitution of the methoxy- or ethoxy- group, while with the bromides of the ortho- derivatives no such change is noted; this marked difference in the reaction of the two classes of compounds is ascribed to the influence of the position of the phenolic ether group in the para- and ortho-compounds.

The action of sodium alcoholate converts the dibromide into alpha-oxy-o-methoxy-benzylidene acetophenone, while the same treatment of the tribromide gives rise to two isomeric substances, alpha-oxy-o-methoxy-brom-benzylidene acetophenone and o-methoxy-brom-benzoyl benzoyl methane (a 1, 3-diketone), Various derivatives of each compound are described.

*Nitrosulphuric Acid and Its Action on Organic Compounds; Part II.:* C. W. Volney.

Dr. Volney presented the results of experimental work on hydrolysis of nitric acid by sulphuric acid and formation of nitric anhydride, the existence of combinations between the anhydrides of sulphuric and nitric acids

having been shown in Part I. of this paper (read November, 1903).

The effect of mixtures of nitric and sulphuric acids on organic compounds was then discussed and compared with the reactions obtained by the use of mixtures of nitric acid and anhydrous phosphoric acid under similar conditions. The conclusion reached was that nitrosulphuric acid or the 'mixed acids' of commerce are not merely mixtures, but contain the product of hydrolytic reactions of sulphuric acid in excess on nitric acid, thus explaining their reaction on organic compounds and production of nitro-substitutions, especially of nitro-cellulose.

*The Chemistry of Rubber Colors:* M. Toch.

Mr. Toch pointed out that many of the ordinary pigments are not applicable to the coloring of rubber goods, either because the color would be changed by the heating and the reagents used in vulcanizing and finishing rubber, or because of some objectionable effect of the pigment upon the rubber mass. Oleic acid, used as a vehicle for aniline colors, is very deleterious. Stearic acid may be used for the same purpose and is less objectionable.

The following were mentioned as being among the most important of the mineral pigments used: Zinc oxide, zinc sulphide, barium sulphate, vermilion (less used than formerly), iron oxide pigments prepared from the sulphate, antimony sulphide, zinc chromate, 'chrome green,' sesquioxide of chromium and ultramarine.

*Notes on the Analysis of Type Metal:* E. H. Miller and M. A. Lamme.

Dr. Miller referred briefly to some of the difficulties experienced in the analysis of type metal alloys, which are explained by the failure to obtain the tin completely in the stannic condition, and recommended that Clarke's separation be followed by the electrolytic deposition of tin as given by Herz, *Ztschr. für Anorganische Chemie,* 37, 1 (1903).

H. C. Sherman,
*Secretary.*

NORTHEASTERN SECTION.

The fifty-first regular meeting of the section was held Wednesday evening, March 16, in Huntington Hall, Massachusetts Institute of Technology, Boston, with President W. H. Walker in the chair. About 1,000 members and invited guests were present.

Professor E. Rutherford, of McGill University, Montreal, gave an address on 'Radioactivity,' in which he reviewed the history of the discovery of the property of certain forms of matter of giving off radiations, and described the properties of such radiations, as Röntgen rays, X-rays, the alpha, beta, and gamma rays of radium, etc.

The theory of the continuous breaking down of the molecule of a high to one of a low molecular weight was adduced to explain the phenomena of the emanations and the enormous amount of energy manifested. The subject was thoroughly illustrated by experiments, among which was the transference of the condensed emanation of radium from one tube to another cooled with liquid air.

Arthur M. Comey,
*Secretary.*

THE ONONDAGO ACADEMY OF SCIENCES.

The February meeting of the academy was held on the nineteenth, at the College of Medicine, Syracuse University.

Mr. I. U. Doust and Mr. W. H. McClelland were elected to membership.

Dr. E. H. Kraus, as a reelected president, delivered an inaugural address, of which the following is an abstract:

*Some Interesting Mineral Occurrences in the Salina Epoch:* E. H. Kraus.

Crystals which proved to be hematite were discovered in sewer excavations in the city of Syracuse during the spring of 1903, and in the summer of the same year celestite was found in the vicinity of Jamesville; the latter mineral up to that time had not been known to occur in that locality.

The crystals of hematite usually occur in the cracks and crevices of the red shale and are from one sixteenth inch to one half inch in length. They occur in scales and plates in which the basal pinacoid is much larger than any of the other faces of the crystal. The hematite, as usual, occurs associated with small quartz crystals.

The mineral celestite does not occur in veins or cavities, but disseminated through the rock, the manner of dissemination differing somewhat in different sections; in some places the crystals were not nearly so perfect as in others, often collected in small circular spots. The crystals have the usual combinations of faces found in celestite as well as the specific gravity and optical properties of this mineral.

While the mineral was originally found near Jamesville it has more recently been found elsewhere and, the author believes, is of general occurrence in the limestones of the Salina. In places where rocks containing the celestite were exposed to the weather, the mineral was dissolved, leaving cavities which by their distinct outlines indicate the character of the material which they had contained. In some localities the crystals were large and their impressions simulate the marks of chisel blades of about three fourths of an inch in width, occasionally single but often crossing one another.

In the rocks where this mineral occurs in circular particles, leaching gives rise to an appearance as if the stone were worm-eaten, and bearing a striking resemblance to the 'vermicular limestone.' The 'vermicular limestones' have given geologists much trouble as to a satisfactory explanation of their formation. That sodium chloride was the original occupant of these cavities seems doubtful. But celestite is soluble in water containing small quantities of sodium, calcium or magnesium-chloride. Analyses of the brines from the different salt-producing sections of the state easily proves the presence of these chlorides. With these facts in mind and knowing that the dissemination of celestite through the rock is not unlike that which would be necessary to form cavities as found in the vermicular and that when such a rock has been leached, the appearance of the resulting rock is like that of the vermicular, the conclusion seems unavoidable that these many cavities now empty in the vermicular must have once contained a mineral of the character of celestite and that by the action of the agencies mentioned above the same was dissolved, leaving nothing but the so-called cells to show its former presence.

J. E. Kirkwood,
*Corresponding Secretary.*

### THE SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

The fifth meeting of the club for 1903–4 was held February 23, in the physical lecture room of Science Hall. The club had for its guest the local section of the American Electrochemical Society, this being the first meeting of the local section. The papers were presented by members of the section. The first paper, by C. F. Burgess, on 'Electrolytic Iron,' was illustrated by specimens and products of pure iron recently obtained by him by electrolysis. One specimen of extremely pure material weighted twenty-one pounds.

The second paper, by Oliver W. Brown, on 'The Electric Furnace,' was a general description of the recent advances made in electric furnace work.

The third paper, by V. Lenher, on the 'Solubility of Gold,' was illustrated by experiments and dealt with some recent work of the author.

Victor Lenher,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### CONVOCATION WEEK.

To the Editor of Science: Having attended a majority of the meetings of the American Association for the Advancement of Science during the past fifteen years I may, perhaps, be considered competent to contribute some impressions in regard to recent tendencies and the future development of the association which they apparently indicate.

It has always seemed to me that in any attempt to solve a problem such as that of the future policy of the association the proper course to pursue is to study the causes which have led up to existing conditions and from these to try and anticipate what the inevitable outcome is to be. Discussion of personal likes or dislikes is profitless if these are manifestly at variance with the general course of

development and whatever I may have to say will be predicated upon that principle.

The one tendency which has been so steadily persistent and so prominent in the development of the association as to overshadow everything else is that of specialization of work, and this factor is unquestionably destined to become more and more prominent from year to year. It was first manifested in the division of the association into its original sections, next in the subdivision of these, then in the organization of special societies distinct from the sections and finally in the further subdivision of the societies and the formation of new ones in accordance with the development of new lines of thought and investigation. This is a condition with which we must reckon and our effort should be to study how it can best be made to serve the objects and interests of the association. Another tendency, of more recent origin, the underlying motive of which I confess I have not been able quite to understand, is the tendency to separate on geographic lines. This is more or less an uncertain quantity and, therefore, its importance may be underestimated, but it is a factor which has to be taken into consideration.

Assuming that this course of reasoning is valid it would seem as if the association should make every possible effort to encourage the formation of new sections whenever the necessity arises and to make the scope of its influence as broad as possible. Many earnest workers in educational and economic subjects find no place open to them in any of the sections and hence the formation of many independent societies entirely out of touch with the association. Many of them meet at other times and places and both time and energy are wasted. On the other hand, the affiliated societies, which have sprung naturally from the influence of the sections, are a source of strength to the association and this could be further augmented by intelligent cooperation.

Much has been accomplished in this direction already, but it has not been systematically pursued. I have elsewhere proposed, and I take advantage of this opportunity again to urge, that an effort should be made to call a meeting of delegates from all societies which could properly be affiliated with the association in order that some uniform basis of cooperation might be secured.

The main province of the association in the future would seem to be that of organization and popularization of science. Let the summer meetings be continued, with the understanding that they are for the purpose of arousing and maintaining popular interest and to serve as a common meeting ground for professional and non-professional scientists, where the social element is to be encouraged and where beginners and amateurs may become acquainted with those whose names and works are known to them, but with whom they have never had the opportunity to become personally acquainted. I know of many instances in which embryo scientists obtained their first inspirations and their first insight into the possibilities which lay before them, through the medium of these meetings.

It may, perhaps, be an open question whether winter meetings in addition are advisable. The tendency seems to be to make these more technical and, perhaps, it might be wiser to encourage this idea. In other words, that at these meetings the affiliated societies should assume the leading position.

It ought to be feasible so to arrange the programs that at the summer meetings the societies could meet with the sections and have the association assume the greater prominence, while at the winter meetings the association could act more as a medium for bringing the societies together at one time and place.

Personally I do not believe in the advisability of meeting in regional sections. The less separation we have on geographic lines the better, although if this tendency is obvious I realize that it would be folly to oppose it. Before expressing any further opinion on this point, however, I should prefer to hear something more definite than has yet been brought forward by those who favor it, not only in regard to reasons for the proposed change, but also, approximately, the details of the arrangements which could be made for such meetings.

It should also be borne in mind that the

members are discussing the policy of the association more or less in the dark, as to the manner in which any changes would or might affect the finances and administration of the association. It would seem as if the discussion ought to include some words from the standpoint of the administration in order that all sides may have a hearing.

Arthur Hollick.

New York Botanical Garden.

The American Association for the Advancement of Science accomplishes a great work in making it possible for large numbers of scientific men to come together from year to year, and in this way alone does much for the promotion of science. The association can well afford to make generous concessions to affiliated and other scientific societies, even though they do not contribute directly to the financial support of the larger organization. We can not help feeling that these other societies are important to the welfare of the general association, and we are decidedly in favor, if possible, of making conditions such that the various societies will see material advantages in affiliating or coming into even closer relations with the older organization, and it would, therefore, seem to us wise to give the affiliated societies a larger representation in the council. We are not afraid of their exercising too much power in that body. They have come into existence to supply a need. Specialists have increased so rapidly that the original sections are not adequate for present conditions. We do not believe that special papers should be read before the sections, but they should either be referred to subsections or special societies.

It is much easier to suggest than to carry out, yet the last two meetings have emphasized the advisability of a more general classification of meetings and papers than has heretofore obtained. This is possible only through the cooperation of all societies meeting at the same time, and one of the great gains from a closer connection between affiliated and other societies and the association, would be the possibility of harmonizing programs. The many branches of science and the multiplicity of interests, renders this extremely difficult, still there are ways in which the matter could be simplified. It seems to us that two general sessions ought to meet every demand; one to mark the opening of the meetings and to permit of addresses of welcome, etc., and another in the evening to give the president an opportunity to deliver his address. The other general sessions amount to little more than a formal confirmation of the action of the council, and it would seem that this body might well be intrusted with all the governing powers, including the election of officers, since its members are elected at various times by the different sections and affiliated societies. Notices for each day could appear upon the program and thus do away with any excuse for a short daily general session every morning. This would allow unbroken forenoons for general meetings, and it would seem as though all the papers in related sciences could be classified. The general and special should receive equal consideration, and we would suggest that morning meetings be devoted to general papers, and afternoon sessions to special papers, which latter should be read before subsections or special societies. Some papers are of general interest to more than one group, and these would naturally have precedence in the morning and could be delivered before a joint session of one or more sections. Some arrangement of special meetings would be necessary for afternoons, so as to avoid conflicts likely to be produced by related subsections or societies holding sessions at the same time. Evenings not already occupied, as stated above, might be devoted to sessions for members of the association, at which two short addresses on topics of general interest could be delivered. Two such meetings might easily be held in different halls, and with proper grouping of subjects, there would be comparatively few who would wish to attend both. In addition to these short, general sessions, which should last an hour or a little over, we would favor continuing the popular complimentary lectures to the people of the city where the meetings are held and for such members of the association as cared to attend. These latter would be longer and more

formal than the short addresses mentioned above. All of these evening meetings could easily finish by 9:30, and give an opportunity thereafter for banquets and social gatherings, which have been a characteristic feature of previous meetings.

We believe that a classified system, such as described above, and including not only the regular papers presented before the American Association but also those before special societies, would do much for the advancement of science in America. The attending scientists would have, in the morning, a series of general scientific papers of interest to most of them, while meetings of subsections or special societies occurring in the afternoon would give an opportunity for the consideration of technical questions. The semi-popular short addresses in the evening would appeal to many of our members, while the more formal public lectures by prominent men would be an important stimulus and result in materially advancing science in America.

E. P. Felt.

## THE WRITINGS OF WILLIAM J. LONG.*

The last quarter of a century has seen a remarkable development of that form of literature which consists of charming popular writings about animals and their doings. A leader in this movement was John Burroughs, whose work combines literary grace with scientific truth to a degree not surpassed by that of any other modern nature writer, and there are several others in this country writing in the same spirit. Recently, however, there have arisen somewhat suddenly into prominence three writers on nature subjects whose works enjoy a popularity far surpassing that gained by any of their predecessors or contemporaries. These three are Mr. Thompson Seton (earlier known as Seton Thompson), Mr. W. J. Long and Mr. C. G. D. Roberts. Of the former I know little, but the two latter have written extensively of New Brunswick animals, and hence I have been much interested in their works, upon which I propose to make some comments from the point of view of New Brunswick natural history.

In examining the works of these two graceful writers, two queries naturally arise: First, as to the cause of their surpassing popularity, and second, as to their real scientific worth. The cause of their popularity is easily found. It does not lie in their literary charm primarily, for in this they do not so far surpass other nature books, but it consists in this, that they tell about animals, not as they are, but as people like to think they are. It is the humanization and idealization of animals, which, under the influence of the remarkable literary skill of these authors, has made their animal stories so popular. To accomplish this end, they have had to cut loose from the trammels of fact which hampered their predecessors, and have given their imaginations full play, thus producing fascinating works of fiction disguised as natural history. It is, however, this disguise which constitutes the chief ground of criticism against these works. We all agree that the use of animals as the heroes of romances is perfectly legitimate, but if such works pretend also to be accurate natural history, they unfairly deceive their readers and dishonestly claim a position to which they have no real title. It happens unfortunately that the works of both Mr. Long and Mr. Roberts are widely accepted as accurate in their natural history by the great majority of readers. Mr. Long positively claims that all he writes is accurate fact based on his personal observation, while Mr. Roberts allows an extensive personal knowledge of animals to be inferred, and takes no steps to correct this popular error.

Mr. Long has published five books on animals, containing many references to New Brunswick. The most characteristic feature of these books, especially of the later, is the marvelous character and remarkable number of the experiences the author claims to have had in his observations of animals. The aggregate of Mr. Long's reported observations, both as to quantity and character, is such that if all he reports is true, he has seen more widely and deeply into animal life than all other students of animal habits taken to-

* Read before the Natural History Society of New Brunswick (Canada), March 1, 1904.

gether. This I am not prepared to believe, especially in the light of the tone of his own writings, which seem to me to show that he possesses neither the temperament nor the training essential to a disinterested observer. I have no proof, with the single exception noted below, that any individual statement of Mr. Long's is untrue; but an experience in the New Brunswick wilderness at least as great as Mr. Long's has given me such a knowledge of the difficulties of observing wild animals in their native haunts that I can not believe that any man has had all of the remarkable experiences reported by Mr. Long. Furthermore, the one case in which I happen to know personally the evidence on which Mr. Long bases a statement does not allow me to entertain a high regard for his accuracy. In his book 'School of the Woods' he claims to have seen fish hawks catch and wound fish which they then dropped back into the water in order to teach their young to dive for them. This statement is criticized by Mr. Burroughs in his article on 'Real and Sham Natural History' in the *Atlantic Monthly* for March, 1903, and in his reply to this article in the *North American Review* for May, Mr. Long reaffirms it, and adds: 'Mr. Mauran Furbish, who probably knows more of the New Brunswick wilderness than any other man, has told me since my book was written that he had seen the same thing.' Thinking I knew the incident on which this statement was based, I wrote Mr. Furbish, who has been my companion in two journeys into the wilderness of New Brunswick, asking what statement he had made to Mr. Long. He replied that he had simply told Mr. Long of our finding one day a wounded gaspereau floating at the foot of a lake and that Mr. Long 'had furnished all the romance and the reason for their being there.' This incident, I believe, gives the clue to the character of much of Mr. Long's work. He does not deliberately invent, but some trifling basis of fact happening to fit in with some theory developed by his sympathies is accepted by him as confirming his surmises, which he thereupon considers and publishes as proven. Mr. Long's books undoubtedly contain a great deal of valuable fact, but this is so mixed with matter that can not possibly be accepted simply on Mr. Long's statement, that it makes his works practically valueless for any scientific purpose.

Mr. Roberts, I believe, nowhere makes any claim that the natural history basis for his animal writings rests on personal knowledge, but that is the impression left with the reader, and Mr. Roberts takes no steps to set him right. Those who know Mr. Roberts are aware that his literary work for several years past has not permitted him to make those journeys into wild New Brunswick essential to the study of its animal life, and that his few earlier trips had not this object in view and were not of a character to permit it. His knowledge of New Brunswick animals has been gained chiefly in the public libraries, museums and menageries of New York City; his material is hence mostly second hand, and it is unfair to his readers that they should be given the impression that these works are founded on a personal knowledge of the animals described. If Mr. Roberts would but state in the preface to his books that his studies are not based upon personal observation of their subjects, but are as accurate as he can make them from other sources of information, he would not only be dealing honestly with his readers but he would, in my opinion, greatly enhance the value of his really remarkable imaginative works.

So opposite are the standpoints from which the scientific and the literary man view animal life, and so entirely indifferent are they to one another's standards, that the two are not only nearly impossible to one person, but they are well nigh mutually exclusive. The charm of the study to the man of science is the triumph of demonstrating the truth. He makes this his sole standard as it is his sole reward. Slowly, patiently, laboriously, indifferent to popular opinion as to popular applause, he makes his resistless advances, testing and proving each step before a second is made. He naturally has little regard, therefore, for showy leaps from scanty fact to sensational generalization, and he has no respect at all for a pretence of scientific knowledge not based upon an honest foundation. The lit-

erary man, especially the new nature writer, seems to view nature chiefly in the light of a fresh supply of literary material, and he values her phenomena in proportion to their adaptability for interesting and clever treatment. To him the truth is not of first importance, and imagination is allowed to improve upon nature whenever she can thereby be made more available for literary uses. All this may be legitimate in literature, but works thus inspired should not expect to be accepted also as science, nor should they pretend to an authority they do not possess.

Smith College. W. F. Ganong.

If the article entitled 'Woodcock Surgery' (Science, February 26) were nothing worse than a frisky, good-natured breeze every one would doubtless be willing to let it pass without notice, but its temper and twists are such as to require a word that may possibly 'seem unkind.' Its author says that Mr. Long "virtually claims that a woodcock not only has an understanding of the theory of casts as adapted to fractured limbs, but is able to apply this knowledge in practise. The bird is represented as knowing the qualities of clay and mud, their lack of cohesion unless mixed with fibrous substances, their tendency to harden on exposure to the air, and to disintegrate in water." "His woodcock is familiar with the theories of bone formation and regeneration—in a word, with osteogenesis." "He divines the functions of the periosteum," etc. Instead of claiming anything of the kind, Mr. Long tells us in simple language what he has seen, offering neither inferences nor generalizations. It is his critic, Mr. Wheeler, who 'virtually' affirms that a woodcock could not apply mud to a broken leg without a knowledge of surgery; and it is much as if he should say that a man who blows on his fingers to warm them or on his tea to cool it has a knowledge of the laws of thermodynamics and is ready to discuss entropy or an indicator diagram. It is the merest commonplace fact that in order to avoid danger, to lessen pain, to save life, to gain pleasure, human beings are constantly performing acts the underlying principles of which they understand scarcely any better than a woodcock understands the principles of surgery. This difference between what may be expected of man and of a bird is probably one of the recondite features of Mr. Wheeler's animal psychology. If this 'serious student' means that action apparently or really intelligent on the part of animals implies scientific training and knowledge and accounts of such action are, therefore, to be contemptuously dismissed as 'untrue,' he has taken ground which he will undoubtedly be left to occupy alone. One wonders that he has not long since exposed Mr. Darwin. The books of the master naturalist are full of anecdotes that, according to Mr. Wheeler, must be discredited. For instance, there is the delightful one of the motherly baboon who stole young dogs and cats which she continually carried about. "An adopted kitten scratched this affectionate baboon, who certainly had a fine intellect, for she was much astonished at being scratched, and immediately examined the kitten's feet, and without more ado bit off the claws" ('The Descent of Man,' Chap. III.). Why does not Mr. Wheeler rise up and say that Darwin 'virtually claims' that the baboon was familiar with the 'Novum Organum' and the 'Positive Philosophy,' and further say that this anecdote is a specimen of the 'drivel in which animals are humanized beyond all recognition.'

The woodcock incident is further discredited because the naturalist was a lad of sixteen when it occurred. The editors of *Bird-Lore* seem to think that lads of fourteen or under are capable of making pretty good observations (see *Bird-Lore*, January-February, 1904). But this incident dates back twenty years, we are reminded. That the lapse of twenty years will certainly or even probably cause a 'distortion and exaggeration of the impressions' made on the mind of a boy of sixteen, even when the impression is exceptionally vivid, implies a theory of memory which is, perhaps, another peculiarity of the critic's psychology.

Finally, ridicule is heaped on Mr. Long because he presumes to bring forward a witness of what he believes to have been another case of animal surgery, and to give the credentials

of that witness. To those who have paid some attention to the nature of evidence it will be a matter of interest to learn, first, that additional witnesses and additional instances do not strengthen a case; and second, that the trustworthiness of witnesses is of no consequence. What a lot of bother men of science would have been spared if they had only known this before; for it is unnecessary to point out that the history of science abounds in accounts of efforts to gather evidence and to determine the weights of various pieces of evidence.

So far as the article 'Woodcock Surgery' affords a cross-section of its author's style of reasoning some of his universals seem to be: (1) Action that results in a causal correlation of antecedent and consequent is intelligent action in the sense that the agent understands the principles involved in the correlation; (2) any phenomenon which *B* has not witnessed *A* can not have witnessed; (3) unless an event is of common occurrence it can not occur at all.

Whom the gods wish to destroy they first lure into premises of this sort.

As regards the 'nature-study' classes in our schools, Mr. Wheeler may be spared that part of his anxiety which relates to the effect of such books as 'A Little Brother to the Bear' and 'Wilderness Ways.' One may well wish that every boy and girl in the land might become acquainted with Killooleet and Cloud Wings and Hukweem. Children and mere lovers of nature on the one hand, and comparative psychologists on the other, owe no small debt to men like William J. Long who have the patience and pluck to spend years in the wilderness home of birds and beasts in faithful observation of their life and habits.

Ellen Hayes.

### THE PRESENT STATUS OF SOIL INVESTIGATION.

An address delivered on this subject before the Association of American Agricultural Colleges and Experiment Stations, November 17, 1903, and immediately published as Circular No. 72 of the University of Illinois Agricultural Experiment Station is discussed by Dr. F. K. Cameron in Science, February 26, 1904, page 343. Dr. Cameron states that the criticisms of his Bulletin 22 (Bureau of Soils) which have appeared are to the effect that the authors of the bulletin (Whitney and Cameron) 'have concluded that the use of fertilizers is of no value in affecting the yield of crops.' He further states that 'these criticisms have generally been copied from Circular No. 72, Agricultural Experiment Station, University of Illinois.'

As a matter of fact this statement does not occur in Circular 72, consequently, the objection to 'inexcusable carelessness of misquoting results and statements in a controversial paper' is strictly applicable to Dr. Cameron's own first paragraph. It is not believed that Cameron or any other theoretical chemist is so ignorant of agricultural science and practise as not to know that the use of fertilizers is of value in effecting the yield of crops. The statement in Circular 72 is that Bulletin 22 is commonly understood to teach that the use of fertilizers 'has little or no tendency toward permanent soil improvement, and that even the effect which they do produce is due very largely, if not entirely, to improved physical condition of the soil.' It is certainly safe to say that scientists and agricultural editors and practical farmers are all agreed that this is the teaching of Bulletin 22 regarding the use of fertilizers.

It will thus be seen that Doctor Cameron devotes much valuable space to a matter which is not pertinent to the discussion.

Both Bulletin 22 of the Bureau of Soils, Washington, D. C., and Circular 72 of the Illinois Experiment Station, Urbana, Ill., are available to the reading public, and consequently it is quite unnecessary and unreasonable to expect Science to reproduce any large part of those publications. The following direct quotation from page 59 of Bulletin 22 fairly illustrates its teaching:

> In the truck soils of the Atlantic coast where 10 or 15 tons of stable manure are annually applied to the acre, in the tobacco lands of Florida, and of the Connecticut Valley, where 2,000 or 3,000 pounds of high-grade fertilizers carrying 10 per cent. of potash are used, even where these applications have been continued year after year for a considerable period of time, the dissolved salt content of the soil as shown by this method

is not essentially different from that in surrounding fields that have been under extensive cultivation.

In England and in Scotland it is customary to make an allowance to tenants giving up their farms for the unused fertilizers applied in previous seasons.

The basis of this is usually taken at 30 to 50 per cent. for the first year, and at 10 to 20 per cent. for the second year after application, but *in the experience of this Bureau, there is no such apparent continuous effect of fertilizers on the chemical constitution of the soil.**

This quotation from Bulletin 22 is not referred to in Circular 72, but many other quotations are made which show this same general teaching and which Dr. Cameron now holds 'are utterly at variance with the complete context and plain meaning of the bulletin.' Of course, the 'complete context' can not be quoted here, but, so far as I am able to judge, this quotation, as well as all others which I have made, are fair samples of the accepted meaning of the bulletin as a whole.

In this connection attention may well be called to the fact that the above quotation is quite out of harmony with the statement on page 64 of Bulletin 22, to the effect that the conclusions of the authors are 'strictly in accord with the experience of good farm practise in all countries.' Probably there is no better farming practised in any country than in England and Scotland. After a full half century of agricultural investigation at Rothamsted Sir Henry Gilbert says,† regarding the effect of farm manure on certain plots of ground:

It has been seen that the unmanured plot has declined in yield and fertility; but there can be no doubt that the farmyard manure plot has, on the other hand, increased in fertility. *Analyses** of the surface soil at different periods *have shown** that it has become about *twice as rich in nitrogen** as that of the unmanured plot. It has, indeed, been shown that a large amount of the constituents of farm manure *accumulate within the soil.**

* Italicized by C. G. H.

† U. S. Dept. Agr., Office of Expt. Stations, Bull. 22, pages 149 and 150. (This most valuable bulletin written by the late Sir Henry Gilbert, himself, giving results of fifty years' investigation at Rothamsted, should be read by any one who reads Bulletin 22 of the Bureau of Soils.)

Again, Sir Henry says:

Referring first to the results obtained on the farmyard manure plot, the average annual produce over the [last] forty years was 34⅞ bushels, and over the fifty years 33½ bushels; in the one nearly 7 bushels and in the other 5½ bushels more than the average of the United Kingdom under ordinary rotation; in both not far short of three times the average produce of the United States, and more than two and one half times the average of the whole of the wheat lands of the world.

Without any manure whatever the average annual produce was 13 bushels over the [last] forty [years], and 13½ bushels over the fifty years.

Dr. Cameron apparently admits, as shown in Circular No. 72, that 'it has been possible on the basis of chemical analysis to advise the use of fertilizers containing potassium on certain Illinois soils with improved yield of crop,' but by the same system which he has so successfully applied in using strictly selected data from the Rothamsted experiments, he evidently overlooked the fact that on the same page of Circular 72 is shown an equally striking case where the chemical analysis of other soils plainly shows the need of nitrogen, the addition of nitrogen to these soils having increased the yield of wheat more than eight fold.

Regarding the use of potassium, however, Dr. Cameron adds:

A soil containing according to analysis an enormous amount of nitrogen (67,000 pounds per acre), an abundant amount of phosphorus (2,000 pounds per acre) but what is regarded as a deficient amount of potassium (1,200 pounds per acre) *produced no corn** when either nitrogen or phosphorus or both [or nothing] were applied; yield about the same, 36 bushels when *potassium,** 40 bushels when *potassium** and nitrogen or 38 bushels when *potassium** and phosphorus were applied. But when *potassium,** nitrogen and phosphorus were all applied, the indications of the analysis were flatly contradicted by a yield of 60 bushels.

This is, indeed, a most peculiar statement both chemically and otherwise. The 'indications of the analysis,' instead of being 'flatly contradicted by a yield of 60 bushels,' are thereby confirmed, for if sufficient potassium

* Italicized by C. G. H.

is applied to this soil, which already contains such an abundance of nitrogen and phosphorus, the yield should certainly rise to 60 bushels or more. Of course, there are reasons why the plots yielding 36 to 40 bushels did not yield 60 bushels instead of only 36 or 40. These reasons are fully explained in Illinois Bulletin No. 93, 'Soil Treatment for Peaty Swamp Lands.' Soils may all look alike to the theoretical chemist, but any one who is familiar with agricultural science and practise recognizes that there are differences in soils. Indeed, it seems pertinent to state that these differences were fully understood by the practical farmers who watched the experiments, and who are now using carloads of potassium salts with very great profit on these soils. In 1903 five plots not treated with potassium yielded 15, 7, 4, 5 and 4 bushels of corn, respectively; while five other plots, with potassium applied, yielded 73, 71, 73, 67 and 70 bushels.

All agricultural chemists will agree with Doctor Wiley's statement wherein he says: "When a man sends to me a specimen of a given soil and writes, 'Please analyze this soil and tell me what crops I can grow on it,' I send him word, 'Ask your soil itself what you can grow on it; in that way, asking your question directly of the soil, you can get your answer, and in no other.'"

Chemists recognize that soils have physical as well as chemical properties. On the other hand, no agricultural chemist of standing will agree with the statement of Whitney and Cameron, 'that a chemical analysis of a soil, even by these extremely delicate and sensitive methods, will in itself give no indication of the fertility of this soil,' understanding that the use of the word *even* is intended to convey the meaning that no other known methods need be thought of if these fail. Furthermore, it is certainly pertinent to the discussion to state here that Professor King, a recognized authority on soils and a careful and exact investigator, found that the chemical analysis of soils, *even by these methods,* furnishes much information regarding the fertility of soils. According to notes which I made from Professor King's address on the differences between some southern and northern soils in the United States, read before the Association of American Agricultural Colleges and Experiment Stations, he found that the northern soils contained 2.39 times as much water-soluble plant food as the southern soils and he also found that the yields of crops produced on the northern soils were 2.47 times the yields produced on the southern soils. This is in direct contradiction to the conclusions drawn by Whitney and Cameron from the very miscellaneous and discordant data reported in Bulletin 22. The investigation by Professor King and his assistants is evidently the most systematic accurate and valuable work which has yet been done by the Bureau of Soils; and it is certainly to be hoped that these investigations will soon be published in full, even though, being connected with the Bureau of Soils, Professor King can not 'anticipate the publication of the proceedings' of the Washington meeting.

The only just criticism of Circular 72 which Doctor Cameron makes in his ten-column article in SCIENCE is in regard to the statement concerning the methods employed by the Bureau of Chemistry in analyzing the Rothamsted soils. These statements were based on notes taken from the public discussion by the author of the *Journal* article* at the Washington meeting. Either Mr. Moore misspoke himself in saying 'fifteen hours' extraction' and 'gravimetric method,' or he said 'five hours' extraction' and 'volumetric method' and I misunderstood him; and I humbly accept Doctor Cameron's scathing rebuke for not having looked it up in the original paper. Cameron also insists upon having mention made of the twenty minutes allowed for settling in his water extraction.

The corrections suggested by Doctor Cameron being accepted the obnoxious statement regarding the work from the two bureaus on the same soil samples would then read as follows:

> It will be observed that the Bureau of Soils by twenty-three minutes' extraction with distilled water at room temperature reports from two to thirteen times as much soluble phosphorus from

* *Journal American Chemical Society*, 24, 94 (1903).

these soils as the Bureau of Chemistry obtained by five hours' extraction with dilute acid of 40 degrees centigrade.

This correction will be made in the third edition of Illinois Circular No. 72. Analytical chemists will recognize how little force there is in this single just criticism in its application to the principles under discussion.

To illustrate his difficulty in finding suitable material for criticism, Doctor Cameron says:

> It is not at all clear why the phosphorus as determined in the two investigations should be compared on the basis of an acre surface with a depth of seven inches, for it is inconceivable that any one at this day, and in view of the well-known work of Darwin and others, would suppose that the same identical seven inches of soil would remain at the surface for any considerable period of time.

This criticism is neither pertinent nor consistent. First, it may safely be assumed that neither earthworms nor crawfish were active in these particular samples of soil during the interval between the two investigations, hence the criticism has no bearing on the point. Second, all results and comparisons reported in Bulletin 22 of the Bureau of Soils are based upon soil samples taken to certain depths; hence the critic is inconsistent. Reports of soil investigations which are written for the benefit of agriculture and agricultural people are best given on the acre basis, because this is the basis used in measuring crop yields, in applying manure, fertilizers, etc. The classic agricultural investigations of Lawes and Gilbert are practically all reported on the acre basis. Seven inches is a common depth for good plowing and this method of reporting results is in accord with the methods* adopted by the Association of Official Agricultural Chemists for collecting soil samples, which recognize that there are differences between soils and subsoils, whereas the arbitrary method of soil sampling, 0–12 inches, 12–24 inches, and 24–36 inches, in depth, as used by the Bureau of Soils (see pages 23–33 of Bulletin 22) commonly mixes surface soil and subsoil in one of the samples.

* U. S. Department of Agriculture, Bureau of Chemistry, Bulletin 67, p. 152.

While it is true that, in the early publication of his paper, Doctor Hilgard anticipated the proceedings of the Association of American Agricultural Colleges and Experiment Stations and of the censorship of the Bureau of Soils over the publication of those proceedings, it is also true that his arguments are unanswerable, as are, likewise, those of Director Hall of the Rothamsted Experiment Station, whose criticism of Bulletin 22 appeared in *Nature* last November, although it is entirely ignored by Cameron.

Cyril G. Hopkins.

College of Agriculture,
University of Illinois.

## SPECIAL ARTICLES.

### ON A LEPTOCEPHALUS OF THE CONGER EEL.*

During late July, 1900, the first eel eggs taken outside of Italian waters were secured by the Fish Commission schooner *Grampus* on the surface of the Gulf Stream off Newport. The development of these eggs was described in the Bulletin of the U. S. Fish Commission for 1901.

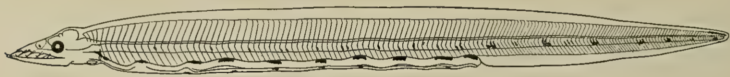
The largest larva reared measured about 11 mm. in length. The larvæ were characterized by the projecting lower jaw, the arrangement of the spots and the number of protovertebræ. Since writing the account which appeared in the bulletin the larvæ have been mounted on slides and a more satisfactory count of the protovertebræ made possible. There is still some doubt about the number of caudal protovertebræ. The count as near as it is possible to get it is $64 + 86$, $64 + 91$, $66 + 89$, $67 + 82$, $67 + 89$, $68 + 81$ and $70 + 86$ in seven larvæ.

On July 31, 1902, the *Grampus* collected a *Leptocephalus* 65 miles south of No Mans Land. It has a total length of 21 mm. and is undoubtedly the same species reared at Woods Hole in August, 1900. It agrees with the 1900 specimens in the projecting lower jaw, the general plan of the coloration, and has approximately the same number of protovertebræ. The protovertebræ are definitely 73 for the abdominal portion of the

* Contributions from the Zoological Laboratory of Indiana University, No. 54.

body and 82 or 83 for the caudal portion. The total number is, therefore, approximately equal to the total number found in the previous larvæ.

The coloration differs from that of the smaller larvæ in that additional spots have developed along the alimentary canal and along the sides. There are ten spots along the alimentary canal from the gill-openings to the anus. Most of these are duplicated above and below, the upper one being the larger. There are seven or eight spots along the tail, not counting the color at the tip, which is apparently much as in the younger larvæ. There is a marked spot near the tip of the lower jaw and another on the upper jaw. There are in addition to these spots, which had representatives in the younger larvæ, a number along the sides over the notochord. In the anterior part of the body, the abdominal portion, these spots consist largely of a single chromatophore between two protovertebræ. Their arrangement on one side is as follows: No. 1 between the seventeenth and eighteenth protovertebræ; No. 2 between 28 and 29; No. 3 between 35 and 36; No. 4 between 39 and 40; No. 5 between 45 and 46; No. 6 between 51 and 52; No. 7 between 55 and 56; No. 8 between 61 and 62; No. 9 between 70 and 71. Those of the other side have a slightly different arrangement.



The spots on the tail have migrated up from the lower margin of the body so that they form a continuous series with those of the middle of the sides instead of with those of the alimentary canal. The last one of the caudal spots is, however, still located at the lower margin. Below it on the margin of the fin fold is a small spot, and there is a black stripe along the upper margin of the body at the base of the dorsal membrane, from a little in front of the last caudal spot to the end of the tail.

The size of this specimen indicates that it is about a month older than those previously described. The breeding season of this eel would, therefore, extend from about the middle of June to the end of July.

C. H. Eigenmann.

Indiana University.

ION ACTION.

It has long been the view of the writers that the term ion action in the sense that it has been used in pharmacology and physiology, is not justifiable and throws no light on the nature of salt action. It seems to have been accepted by many physiologists that the differences observed in the action of a series of analogous salts possessing, for instance, a common anion are to be attributed to a specific action of the cations upon the tissue. Such a conclusion seems to be unwarranted. Recent work on the catalytic decomposition of hydrogen peroxide offers a good example to illustrate our views. In a recent number of the *American Journal of Physiology* there appeared an article by Neilson and Brown* entitled ‘The Effect of Ions on the Decomposition of Hydrogen Peroxide by Platinum Black.’ After a study of the effect of a series of sodium salts and also a series of chlorides on the rate of the catalytic decomposition these authors conclude: ‘In the catalytic decomposition of hydrogen peroxide by platinum black the cation, in general, has an inhibiting or depressing effect, and the anion has an accelerating effect.’ We have recently shown† that the inhibitory action of certain salts on the catalytic decomposition of hydrogen peroxide by various metals is due to the formation of a thin insoluble film over the surface of the metal by the action of the salt on the metal. Thus it was shown that the catalysis by a given metal is inhibited by those salts whose constituent acid yields an insoluble salt with the catalyzer. Thus the catalysis by silver is inhibited by soluble chlorides, brom-

* *Amer. Jour. of Physiol.*, Vol. X., p. 225, 1904.

† *Amer. Chem. Jour.*, Vol. XXIX., p. 397, 1903.

ides and iodides, whereas fluorides do not inhibit the catalysis. It is to be observed that silver chloride, bromide and iodide are insoluble and that silver fluoride is soluble. This fact explains why chlorides, bromides and iodides inhibit the catalysis while fluorides do not, as in the latter case no insoluble coating can be formed. Silver cyanide is insoluble and hence hydrocyanic acid and the soluble cyanides inhibit the catalysis by silver. Thallium resembles silver in the solubility of its halogen salts, *i. e.*, the fluoride is soluble while the chloride and bromide are insoluble, and similarly soluble chlorides and bromides inhibit the catalysis by thallium while fluorides do not. Thallium differs from silver in that its cyanide is soluble and it was found that hydrocyanic acid has only a slight inhibitory action on the catalysis by thallium and this result is due to the fact that the metal is dissolved and hence the action of hydrocyanic acid on thallium is not at all comparable to its action on silver. Using freshly cut shavings of thallium the formation of the film on treatment with potassium bromide can be directly observed. On the other hand, hydrocyanic acid accelerates the catalysis by copper sulphate and ferrous oxide and also by finely divided copper and iron. It was found that if the salts of a given acid exert a retarding effect on the catalysis by a given metal the ammonium salt retards more than the corresponding sodium or potassium salt. This is also capable of simple explanation. Ammonium is a far weaker base than sodium or potassium, and is, therefore, more easily replaced by the catalyzer.

The ammonium salt thus lends itself more readily to the formation of a film. Thus the action of certain salts on the catalysis of hydrogen peroxide by metals is readily explained when we take into account the simple and well-understood chemistry of the substances with which we are dealing. It is true that the action of all inhibitors has not been explained as yet and in some instances undoubtedly other factors play a part, as has been found in the case of ammonium sulphocyanate. The action of accelerators is not as yet perfectly clear, but when the explanation is reached it will certainly take into consideration more the chemistry of each individual substance than the mere fact that they are in the ionic state. In general the sodium salts of the organic acids accelerate the catalysis. In our opinion the hydrolysis of these salts is to be taken into account as one factor in this acceleration, since the alkalies promote the decomposition of hydrogen peroxide and increase its instability. When we state that a thing is an anion or a cation we by no means exhaust the chemistry of the ion as seems to be sometimes inferred. An attempt to explain the action of inhibitors on the catalysis of hydrogen peroxide by metals in terms of the ionic theory as ordinarily employed in physiological work leads to conclusions that are entirely misleading. Thus ammonium chloride inhibits the catalysis by silver and thallium much more than sodium or potassium chlorides. To conclude from this that the ammonium ion is the inhibiting agent would be entirely erroneous. It is the chlorine in all cases that acts on the metal to form the film and the ammonium chloride inhibits the catalysis more strongly because the chlorine is less firmly held. To state from such facts that the cation retards the catalysis would neither be expressing a fact nor offering an explanation of the supposed fact. In a subsequent publication* Neilson and Brown make the following statement: 'In our work on the effect of ions on the decomposition of hydrogen peroxide by platinum black, we obtained results which may be explained by the assumption that in general the anions exert a stimulating action, and the cations a depressing action, so that the action of a given salt depends on whether the anion or cation is the more powerful.' The writers fail entirely to see the slightest suggestion of an explanation.

It seems to be true that most chemical reactions occur between substances in the ionic state, and the necessity of the presence of water for many chemical reactions has led some chemists to assume that chemical interaction only occurs between ions. This is still an open question. Even in so simple a case

* *Amer. Jour. of Physiology*, Vol. X., p. 336, 1904.

as the hydrolysis of cane sugar by acids, an action which has been studied so carefully and been found to be proportional to the number of hydrogen ions, it is not proved that the hydrolysis is due to the hydrogen ion independently of the anion, and it seems most improbable to the writers that such is the case. The monatomic ions differ from atoms only in the possession of an electric charge. Hence ion action can only differ from atomic action in consequence of this charge. The writers have been unable to find any evidence in physiology or pharmacology that an ion ever effects a functional change in consequence of this charge. Such a demonstration would be heartily welcomed. The expression ion action in the sense in which it is so often used in physiological literature seems unwarranted.

It must be added that the brilliant results which have been attained in the field of salt action are in no way affected by whatever explanation they may ultimately receive.

A. S. Loevenhart,
J. H. Kastle.

### DEATH GULCH.

It is certain that nowhere within a like area can be found so many natural features of greatest interest as those to be seen in the Yellowstone National Park.

Not the least of these is Death Gulch, discovered in 1888 by Walter Harvey Weed, of the United States Geological Survey.

Mr. Weed's description of his discovery appears in Science, February 15, 1889, and contains information concerning geological features, comparisons with the Death Valley of Java and other matters of general interest.

At this time bodies of five bears, one elk, many small mammals in various stages of decomposition, and numerous insects were found. None of the animals showing signs of violence, Mr. Weed concluded death was caused by poisonous gas.

In 1897 Dr. T. A. Jaggar, Jr.,* visited the gulch, finding the carcasses of seven grizzlies and one cinnamon bear.

Tests made at various places along the bottom of the gulch failed to show sufficient gas to extinguish the flames of burning matches.

* *The Popular Science Monthly*, February, 1889.

A year or two later Capt. H. M. Chittenden visited the gulch and found no animal remains nor any evidence of noxious gases.*

This experience caused him to express considerable doubt as to the authenticity of previous accounts.

As both Weed and Jaggar have indicated, the gulch is of such a nature, it is almost certain to be cleaned out periodically by freshets resulting from melting snow or heavy rains.

Quoting from the journal of the corporal in charge of the Soda Butte Station, the following extract needs no comment.

*May 3, 1898.*—Lt. Lindsley and Corpl. Herb left station for Cache (Creek). Followed trail to Death Gulch. Crossed Cache Creek at Death Gulch and patrolled two gulches to find the one in which supposed skeletons were to be found. Run into a bear track and in following it, came to Death Gulch. Corporal Herb went into it to the bottom and counted seven bear, brown silvertip and one grizzly. Part of gulch covered with snow. Signs of bear abundantly on both sides. The smell is that prevalent throughout the sulphur regions of the park. On being in the bottom of the gulch the sensation experienced was that of dizziness leaving a headache behind.

*May 28, 1898.*—Pvts. Root, McDonald and Edwards, mounted to Death Gulch. Counted carcasses of seven bear and one fox. Saw fresh signs of large bear on east side of gulch.

*August 10, 1902.*—Pvt. Wilson from station to Death Gulch, found carcass of bear having recently died, probably within twenty-four hours.

It has been my good fortune to visit Death Gulch, three different times. The first in 1900 when returning from Hoodoo Basin, our party camped near the mouth of Cache Creek and visited the gulch. We counted the carcasses of four large bears, and saw the remains of many other animals, represented mainly by bones with occasional tufts of hair. At this time the smell of sulphureted hydrogen was noticeable, and I determined then to learn, when possible, the composition of the gas of the gulch.

With this end in view, I went to the park in June of the past year, with apparatus for the analysis of gases.

* 'The Yellowstone National Park,' fourth edition, p. 335.

Upon reaching Soda Butte Creek, however, I found the waters too high to permit safe fording with a wagon, and had to be content with a horseback ride to the gulch without my apparatus. The only fresh animal remains I then found were those of a small bear which I supposed was the bear Corporal Wilson, of Soda Butte Station, had discovered the preceding year. The smell of sulphureted hydrogen was very strong, and later I noticed the silver coins I had in my trousers pocket while in the gulch were much tarnished.

In August we were successful in getting the apparatus over to the gulch. The wind was blowing at a fair rate during all the time we were in the gulch, and occasional sharp showers of rain occurred.

Notwithstanding the extremely favorable conditions for the rapid diffusion of gases, the air near the bottom of the gulch showed the presence of more than ten per cent. of carbon dioxide, and strong traces of sulphureted hydrogen. A search for the outlets of the gas showed fissures on the *sides* of the gulch from which the gas literally poured. One crevice in particular, an opening about fourteen inches long by four inches high, furnished so much gas we decided to analyze it, and found a little over one per cent. of sulphureted hydrogen, and more than fifty per cent. of carbon dioxide, and we have reason to believe the percentage of these gases was even higher than these figures, for there were several ways in which the air, constituting the remainder of the sample, may have entered the bottle. But these results show how, upon still days when gaseous diffusion is not very active, a sufficient percentage of gases to cause death might remain mixed with the air along the bottom of the gulch.

The question of sulphureted hydrogen poisoning has not been very carefully studied, and it is difficult to obtain any reliable data concerning it.

The following translation, however, gives some information on this point:*

Lehman states that when the proportion of sulphureted hydrogen in the atmosphere reaches one to three parts per thousand, animals die in it in ten minutes, with apoplectic symptoms and great difficulty in breathing.

An atmosphere containing one half part per thousand sulphureted hydrogen produces death with cramps and œdemic inflammation of the lungs.

It further produces rhinitis, conjunctivitis and laryngitis.

It may be characterized as a blood poison which decomposes the oxyhæmoglobin in the body to sulphmetahæmoglobin.

It may be concluded, then, that about one tenth per cent. in air is a sufficient amount to produce fatal results. This percentage would be reached by the dilution of the gas issuing from the fissure to ten volumes, which, considering the large quantity coming from this and similar fissures, would require a very large volume of fresh air. This dilution would reduce the carbon dioxide to five per cent., which would be considered generally a dangerous quantity.

Another interesting point in connection with the question of the poisonous effects of sulphureted hydrogen gas is that concerning its effect when associated with large amounts of carbon dioxide.

Would it not, for several reasons, be more dangerous, when associated with five per cent. of carbon dioxide? This phase of the question deserves careful investigation.

At the time of my last visit we found the remains of one small bear, the one I had noted in June, another bear, elk hides, three birds, including a mountain blue jay and a great horned owl, numerous old skeletons not identified, beetles, moths, butterflies, flies and maggots.

It is interesting to note, in respect to the dead maggots, the intermittent action of the gas. After the death of the bear on which they were found the atmosphere permitted the presence of flies which laid their eggs on the carcass. Maggots developed, lived for a time, until the gas became sufficiently strong to kill them.

Flies were flying about the gulch while we were carrying on our work. Some of these we caught and held in the escaping gas from the crevices. In each case death occurred on six seconds' exposure to the gas.

* 'Toxikologie für Thierärtze,' Eugene Fröhner, 2d ed., pp. 146, 147.

The slope from the bottom of Death Gulch from the mouth upward is very great, affording a hard climb for any who may attempt to pass up it. Occasionally, shelves are encountered adding to the difficulty of reaching the place where the animals are found. It is above one of these shelves or steps where all of the carcasses were lying, and the floor of the gulch at this place is comparatively level for a distance of twenty feet or more. At the upper end of this space and about four feet up the side is the fissure described. You may see this offers a fine opportunity for the accumulation of gas.

Thinking of the preservative effects of the gas, I believed at first the bear discovered by 'Pvt. Wilson' was the one I found the following June but later learned that the former was a large bear from which the claws had been taken by the soldiers, while the latter was a small bear still retaining its claws.

Water flowing in the upper part of the gulch has a distinct acid reaction. One determination showed the acidity calculated to sulphuric acid to be equal to one third of a gram to the liter. This acidity disappears before the lower part of the gulch is reached, a sample half way down from the top giving a neutral reaction.

The production of gas is probably connected with this neutralization of the acid water. The action of the acid on carbonates and sulphides liberates the gases.

The symptoms experienced by members of our party while in the gulch were not those of asphyxiation, the usual result of the action of carbon dioxide, but while no two were affected exactly alike, dizziness was noted in each case. In addition to dizziness one had nausea, another headache and the third was dizzy but noticed no other effect.

Taken altogether, the phenomena of this region are most interesting and deserve further study. In taking samples of the gas it was necessary to watch the flow of acidulated water containing cadmium sulphate, in which the sulphureted hydrogen was collected, to see that none of the precipitated cadmium sulphide was siphoned off.

Bending over watching this intently I was almost overcome by the gas, and but for the assistance of my friends in getting to fresh air I should have remained with 'Wahb' and his brethren at the bottom of Death Gulch.

F. W. Traphagen.

Montana State College,
Bozeman, Montana.

A LOACH FROM NANAIMO.

Through the kindness of Mr. Jaeger, of Brannan St., San Francisco, Stanford University has received a live specimen of a very mysterious fish. It is a loach, an eel-shaped fish with the head of a sucker and the beards of a cat-fish, a group of fishes abundant in the Old World in the brooks from Ireland to Japan, but never before found in America.

The loaches are very hardy, as much so as a salamander, and they sometimes come out into the wet grass in search of insects.

This loach was brought to San Francisco in a coaling ship from Nanaimo. He was said to have been found in a puddle in the coal-bank. He was put into a tumbler of water at San Francisco, and then revived. When I found him he was still in the glass of water and lively enough, the bottom of the glass being covered with coal dust.

His origin is a puzzle. Some patriotic Englishman might have brought a loach to Nanaimo. Some Chinaman may have carried about a live loach as good medicine. Some Japanese may have had him in his little tray-garden. It is not easy to conceive that this family should be native to America and that we should have overlooked it so long, while describing so many Asiatic and European species.

This loach has six barbels, short dorsal, a rounded caudal. It can not, therefore, belong to any one of the three European genera. Its place is in the genus *Orthrias,* lately framed by the writer for a species from northern Japan. But the new loach is not this species, nor does any one of the few Chinese species of *Orthrias,* of which I find accounts, resemble it very much.

This is clear. The loach from Nanaimo belongs to a new or rare species. It is either native to Vancouver Island or else it has been brought over alive from China. Meanwhile

the type cheerfully lives in the aquarium, feeding on mosquito larvæ and little tadpoles. Who will find a second specimen?

DAVID STARR JORDAN.

## QUOTATIONS.

### THE DEPARTMENT OF AGRICULTURE.

THERE is grumbling all the time on account of the continually increasing demands of the Department of Agriculture. For the fiscal year 1897–98 its appropriation was $3,182,902. For the current year the appropriation is $5,478,160, and the department will cost $6,229,880 next year.

Although the amount spent by the department is large, other countries are expending proportionately more each year for the same purposes. The latest obtainable figures, as given in a recent report from the senate committee on agriculture and forestry, show these to be the appropriations of several foreign countries for the encouragement of agriculture:

| | |
|---|---|
| France | $ 9,020,000 |
| Austria | 9,275,000 |
| Hungary | 9,400,000 |
| Russia | 25,280,000 |
| Japan | 3,750,000 |

In order that these figures may mean something, the committee has calculated the amount spent by each nation, including the United States, for each acre of tillable land and for each person in the agricultural population. These figures are:

EXPENDITURE PER ACRE OF AGRICULTURAL LAND.

| | Cents. |
|---|---|
| France | 9.8 |
| Austria | 13.3 |
| Hungary | 12.4 |
| Russia (about) | 4 |
| United States | 1.3 |

EXPENDITURE PER CAPITA OF AGRICULTURAL POPULATION.

| | Cents. |
|---|---|
| France | 52 |
| Austria | 69 |
| Hungary | 90 |
| United States | 35 |

Russia, with an area of 8,660,395 square miles, maintains 102 experiment stations, or one to every 84,906 square miles. The United States, with 3,692,125 square miles, has sixty experiment stations, or one to every 61,535 square miles. The other extreme is reached with Belgium, where, in a country containing 11,373 square miles, fifteen experiment stations, or one to every 758 square miles of territory, are maintained. Germany and France maintain a station for every 3,000 square miles of their territory, roughly. In no section of the United States are there as many stations in proportion to the land surface as there are in Germany and France. In the states on the Atlantic seaboard there is one station to every 24,000 square miles of land. Texas, with one federal experiment station, is 27 per cent. larger than all of France and Germany, with their 151 stations. The ratio of experiment stations to area in France and Germany is 96 to 1 as compared with Texas, 28 to 1 as compared with Minnesota and the Dakotas, and 39 to 1 as compared with our Pacific states.

The quarrel that the public has with the Department of Agriculture does not hinge on the amount of its annual appropriation. There has never been any disposition to treat it in a niggardly fashion, but the impression is general that great sums of money are wasted on frivolous enterprises.

The free distribution of seeds is the most notorious of the improper expenditures of which the system is guilty, and the amount of money involved in this is about the same as the annual increase in the appropriation granted by congress. The Weather Bureau, which costs the department $1,330,000 a year, is pretty generally laughed at now.

If the department devotes itself to its legitimate business, and accomplishes its functions properly, it will not be hampered by any lack of funds.—The N. Y. *Sun*.

## JAMES HYATT.

DR. JAMES HYATT died at Bangall, N. Y., on February 27, in the eighty-seventh year of his age. He was one of the earliest members of the American Association for the Advancement of Science, also a member of the New York Lyceum of Natural History, now the Academy of Sciences, and one of the founders of the Torrey Botanical Club. With him

passes away one of the last representatives of the early pioneers in scientific work in old New York. To the labors of this group of men, among whom were Professors Wood and Torrey, we owe many of our privileges to-day in the scientific world. Dr. Hyatt averaged during the years between 1860 and 1870 twenty lectures a week in sixteen schools and colleges, besides holding the chair of chemistry and toxicology in the Woman's Medical College. He was the author of 'First Lessons in Chemistry,' published in 1839, and 'The Elements of Chemistry,' published in 1856. At the time of his death he was a volunteer observer of the Weather Bureau. It is well that we honor the memory of these pioneers. It was they who fostered the spirit of learning and the love for science when the humanities alone were thought worthy of the attention of those who sought education. To their labors and their foresight we owe our great scientific societies and associations which exercise so potent an influence on the thought and activities of the educational world of to-day.

John J. Schoonhoven.

## HANS HERMANN BEHR.

There died in San Francisco, March 6, 1904, Dr. Hans Hermann Behr, in his eighty-sixth year. His work belonged to the preceding generation; for though the brightness of his intellect was undimmed to the last, yet the feebleness of his body prevented his doing scientific work during the last years of his life, when his position as curator of the Entomological Department of the California Academy of Sciences gave him leisure. His large and valuable collection of lepidoptera is in the possession of the California Academy of Sciences and contains, besides his own types of California insects, duplicates of the types of Xantus and Boisduval and others. The collection is cosmopolitan and is probably the most complete collection of Californian lepidoptera in existence. He attended the universities of Halle and Würtzburg, but took his degree from the University of Berlin. He numbered among his friends some of the leading scientific men of the age, Alexander von Humboldt, Virchow, Schlechtendahl, Naumann, Garmar, Ferdinand von Mueller, Dr. Hillebrand, Louis Agassiz, Max Müller and others.

For many years he was professor of botany at the California College of Pharmacy and he wrote two little books on the 'Flora of San Francisco' to assist the students. The 'Introduction' to the earliest 'Local Flora' shows that he was abreast if not ahead of his time, and also gives an original outline of the system of classification showing a complete grasp of the orders of plants that is very rare. He kept no record or copies of his publications, and it would be a work taking some time to unearth them from the German and American periodicals where they appeared.

He was a many-sided man, wrote German poems of beauty and genuine feeling, wrote a story of life in the Philippine Islands which was published in the *Atlantic Monthly*, and a novel of life in California published in a German magazine. He understood every language of Europe. Greek and Latin were about as familiar to him as English and he could quote from the classics indefinitely. He was a purist in the formation of scientific terms, and such words as 'cotype' and a genitive like 'Salmonorum' aroused his contempt and wrath. During his early manhood he was a deep student of Sanscrit and he learned Hebrew when a boy. He was one of the early members of the now famous Bohemian Club of San Francisco. The papers which he wrote for the amusement of the club have been lately collected and published under the title of 'The Hoot of the Owl,' to amuse and charm every one with their quaint and original humor.

Alice Eastwood.
California Academy of Sciences.

## SCIENTIFIC NOTES AND NEWS.

President Carroll D. Wright has decided not to call a spring meeting of the council of the American Association for the Advancement of Science, in view of the fact that there seems to be no business of sufficient urgency to warrant it.

Dr. Simon Flexner, director of the Rockefeller Institute, New York, has been elected

president of the American Association of Pathologists and Bacteriologists.

A COMMITTEE appointed in connection with the celebration of President Eliot's seventieth birthday has decided to invite Mr. John Sargent to paint a portrait of President Eliot.

A COMPLIMENTARY dinner is to be given this week to Rear Admiral George W. Melville, U.S.N., by the Institute of Naval Architects of Great Britain. The organizing committee includes the Earl of Glasgow, Lords Brassey and Inverclyde, Admiral the Right Hon. Lord John Hay, dean of the British Navy; Sir William White, chief constructor; Admiral Durston, engineer-in-chief, and Admiral Hopkins.

DR. L. O. HOWARD, chief of the division of entomology and permanent secretary of the American Association for the Advancement of Science, has been elected a foreign member of the Société Nationale d'Agriculture de France.

GENERAL BASSOT has been appointed director of the Observatory at Nice, in the place of the late M. Perrotin.

DR. J. N. LANGLEY, F.R.S., professor of physiology at Cambridge University, has been given the degree of doctor of laws by St. Andrew's University.

THE council of the Royal College of Surgeons in Ireland has adopted the following resolutions: "That the president, vice-president and council express their gratification at the appointment for the first time of a medical man to the office of provost of Trinity College, and congratulate Dr. Anthony Traill on his appointment to that distinguished position."

PROFESSOR E. B. WILSON, of Columbia University, will spend the summer at the Naples Zoological Station.

PROFESSOR C. S. SHERRINGTON, of Liverpool University, will open his course of Silliman lectures at Yale University on April 22.

THE subjects of the Herter lectures being given this week at the Johns Hopkins University by Professor Paul Ehrlich are: (1) 'The mutual relations between toxine and antitoxine'; (2) 'Physical chemistry versus biology in the doctrines of immunity'; (3) 'Cytotoxines and cytotoxic immunity.'

UNITED STATES AMBASSADOR TOWER, on April 7, presented the New York Geographical Society's Cullom medal to Dr. George von Neumayer, director of the Hamburg Nautical Observatory, for distinguished services to science and especially for the discoveries which he made in his expeditions to Australia.

THE Council of the Royal Geographical Society has decided to award the two Royal Medals for this year to Sir Harry Johnston, well-known for his discoveries in Africa, and to Commander R. F. Scott, R.N., who is returning from the Antarctic regions. Two of the other honors at the disposal of the council have been awarded for Antarctic work. One of these, the Murchison grant, has been awarded to Lieutenant Colbeck for his services while in command of the relief expedition. It will probably take the form of a silver globe, designed by the president, showing the route of the expedition. It has been decided to present the Gill memorial to Captain Irizar, of the Argentine navy, for his rescue of the Nordenskjöld Antarctic expedition. The Cuthbert Peek grant will be presented to Don Juan Villalta for geographical discoveries to the east of the Andes while in command of a Peruvian exploring expedition; and the Back grant to Dr. M. A. Stein for his geographical work in Central Asia, and especially for his mapping in the Mustaghata and Kuen Lun ranges.

THE Carnegie Institution has made a grant of $500 to Professor Henry S. Carhart, of the University of Michigan, to be used for the determination in absolute measure of the electromotive force of Clark and Weston standard cells, and for the determination of the electrochemical equivalent of silver. Professor Geo. W. Patterson, Jr., is engaged with Professor Carhart in this work.

MR. WILLIAM CAMPBELL, of the department of metallurgy of Columbia University, has been granted $1,500 by the Carnegie Institution for a study of the effect of heat treatment on the microstructure and on the physical properties of iron and steel.

THE legislature of Porto Rico has appropriated the sum of $5,000 to defray the expenses of an investigation into the prevalence

of ankylostomiasis in the island. The investigation is to be conducted by Captain Ashford, of the Military Hospital.

Commander Thomas Arthur Hull, a recognized authority on nautical surveying and navigation, at one time superintendent of charts in the British hydrographic department, died on March 25 in his seventy-fifth year. The death is also announced of Professor Emile Laurent, the Belgian botanist.

Ground has been broken at Cold Spring Harbor, Long Island, for the new building to be erected for the station of experimental evolution of the Carnegie Institution, of which Professor Chas. B. Davenport is the director. The structure will be 65 x 35 feet, of brick covered with stucco, two and one half stories high. It will take about two months to complete the building. It will be located in a field a short distance north of the state fish hatchery buildings, and about an equal distance south of the laboratory of the Brooklyn Institute of Arts and Sciences.

The decision of the American Society of Civil Engineers not to join the other engineering organizations in accepting Mr. Andrew Carnegie's offer of a new building on Thirty-ninth and Fortieth Streets, New York, has been followed by the announcement that the society had completed a real estate purchase which will make possible the enlarging of its clubhouse on Fifty-seventh Street to twice its present size. The society has bought the lot on the south side of Fifty-seventh Street, 140 feet east of Broadway, immediately adjoining its building on the west. Plans will be prepared immediately for extending the structure over this lot, which has a frontage of 25 feet and a depth of 114 feet. The exterior of the new addition will be made to conform with the present building.

The Peary Arctic Club has been incorporated. The incorporators state they desire to associate themselves together to promote and maintain explorations in the Polar Sea, headed by Lieutenant Peary, and to provide funds for the same.

The subject for the Sedgwick prize essay, at Cambridge University, for the year 1906 is 'The characters, geographical distribution, sources and mode of transport of the boulders of the Cambridge district.' The essays must be sent in to the Registrary on or before October 1, 1905. The prize is open to all graduates of the University of Cambridge who shall have resided sixty days during the twelve months preceding the day on or before which the essays must be sent in.

To inaugurate the opening of the Simplon Tunnel an exposition will be held at Milan from April to November, 1905. Special prizes will be given for air navigation. It is to be international, except for the fine arts, which will be exclusively national.

It is announced that an association of English manufacturers has chartered the steamer *Lake Megantic,* belonging to the Canadian Pacific Railway Line, for a trip around the world with an exhibition of British goods and manufactures. She will leave London April 27 and be fitted out with samples of goods manufactured by the best British industrial firms. She will make her first call at Halifax, and from here go to St. John's, Newfoundland, and afterwards to Canadian ports. From Canada the exhibition will sail to the West India Islands, thence to South Africa, and thence to Bombay via Mauritius. From Bombay, Colombo, Madras, Calcutta and Rangoon will be visited; then, sailing by Penang through the Straits of Malacca, touching Singapore, the exhibition will visit Hongkong, Shanghai, Nagasaki and Yokohama, sailing thence to Australia and New Zealand. Homeward, the vessel will call at Buenos Ayres, Montevideo, Rio de Janeiro and West Africa.

We learn from the London *Times* that the International Marine Association, of which the president is M. Charles Roux, has issued the program of its fourth congress, which is to be held in Lisbon from May 22 to May 28. Among the topics which are to be discussed under the general head of oceanography and hydrography are bathymetric charts and the latest cruise of the Prince of Monaco's yacht. The question of North Atlantic weather forecasts will be considered, as also the various conventions for the unification of all matters connected with navigation on the high seas and the treatment of vessels in foreign ports.

The question of the improvement of ports by the installation of practical appliances is deemed so important that it has been given in the program under a separate heading. The Panama Canal, sailors' charitable associations, territorial seas, international marine statistics, yachting, sardine fisheries and wireless telegraphy also figure in the list of matters to be dealt with.

The London *Times* states that Sir Alfred Jones entertained at lunch, in Liverpool, on February 22, a company of merchants and scientists to meet Professor Boyce on his return from Egypt, and to hear his statement as to the success of the anti-malarial fever expedition to Ismailia. Sir Alfred Jones presided and welcomed Professor Boyce. Professor Boyce said that when Major Ross visited Ismailia in September, 1902, there were 2,000 cases of malaria annually in a population of 9,000 people, of whom 2,000 were Europeans. The authorities at Ismailia loyally carried out Major Ross's suggestions as to filling up marsh land close to the town and cleaning out small irrigating channels and stagnant waters. That involved an expense of £4,400, and at the same time they organized a drains brigade and petroleum brigade, as a result of whose work people could now sleep in any of the houses in the European quarter without mosquito nets. From something like 2,000 cases of malaria a year the number had been reduced, according to the latest statistics drawn up by an independent medical officer, to 200. As a matter of fact, there were no fresh cases of malarial infection in Ismailia; there had been no deaths among Europeans during the year, and only four among natives, against something like 30 deaths the year before. Such had been the improvement that Prince D'Arenberg, president of the Suez Canal Company, informed him that he hoped before two years were out to see Ismailia regarded as the sanatorium and watering place for Cairo. Tropical medicine was bringing us to think that after all this little country of ours had been for centuries teaching medicine applicable to our own country and domestic life without thinking of our great empire all over the world. The time had come when they must teach students a medicine applicable to the whole world. Major Ronald Ross, C.B., remarked that the success of the anti-malarial campaign at Ismailia had taught two things—that it was possible to rid a large town entirely of mosquitoes, and that it was equally possible to eradicate malaria. He had been asked by Mr. Brodrick to draw up a report as to malaria cases in India, which numbered 300,000 admissions to hospitals among the troops and the gaol prisoners. With the Ismailia figures before him he would do that with complete confidence, for he was sure that very shortly they would reduce that immense admission rate to one third of its former number.

We learn from *Nature* that a bill for rendering compulsory the use of the metric system of weights and measures in the United Kingdom was read a second time in the House of Lords and referred to a select committee. The bill provides that the metric system shall become compulsory on April 5, 1906, or at such later date as may be directed by His Majesty by order in council. It is, therefore, left to the discretion of the government to fix the date for inaugurating the compulsory adoption of the system. In moving the second reading of the bill, Lord Belhaven referred to the recommendations of the select committee of the House of Commons in 1895, and pointed out the educational and commercial advantages which would follow the adoption of the metric system in the place of our present irrational standards. Lord Kelvin, speaking in support of the bill, remarked that in Germany, France and Italy, no inconvenience had resulted from the introduction of the metric system. He said it was of interest to know that the decimal system originated in England. In a letter dated November 14, 1783, James Watt laid down a plan which was in all respects the system adopted by the French philosophers seven years later, which they suggested to the King of England as a system that might be adopted by international agreement. James Watt's objects were to secure uniformity and to establish a mode of division which should be convenient as long as decimal arithmetic

lasted. Speeches in favor of the bill were made by Lord Wolverton, the Marquis of Lansdowne and the Earl of Rosebery.

## UNIVERSITY AND EDUCATIONAL NEWS.

Mr. John D. Rockefeller has given $500,000 to the Johns Hopkins Hospital, in order that the work of the institution may not be curtailed owing to the losses from the recent Baltimore fire. The Maryland legislature has voted $25,000 annually for two years to the Johns Hopkins University.

By the will of Mrs. Farnham, widow of the late Professor Henry Farnham, Yale University receives $52,500 for the endowment fund of the medical school and $39,000 for the endowment fund for the library.

The Goldsmiths' Company has transferred to the University of London the technical institute in South London which it has maintained for the last twelve years. The value of the buildings and land is estimated at about $500,000. As work of the kind that the company had been doing will henceforward be paid for by public funds, the institute has been made over to the University of London for higher education.

The London *Times* states that the physiological laboratory committee of London University has presented a report upon the work done in the laboratory during the past two years. This institution was established in February, 1902, to provide facilities for original work in physiology and experimental psychology, and to publish by means of lectures to advanced students the results of recent work in this branch of study. For the establishment and maintenance of the laboratory the senate are chiefly indebted to Mr. Walter Palmer, M.P., Mr. Alfred Palmer, and Mr. G. W. Palmer, M.P. During the past two years eleven courses of eight lectures each have been delivered in the laboratory, and arrangements have been made by the senate with Mr. John Murray for the publication, under the authority of the university, of such of these courses as may be from time to time approved. The first volume published in this series has been Dr. A. D. Waller's 'On the Signs of Life.' The laboratory has been used for various researches by 20 qualified students, and 23 communications from persons working in it have been published in the *Proceedings of the Royal Society* and other scientific journals.

The Messrs. Mallinckrodt, of St. Louis, have agreed to pay $500 to a chosen student of chemistry in the graduate school of Harvard University during the year 1904–1905, on condition that this student contract to serve in the Mallinckrodt Chemical Works during the year 1905–1906 at a suitable salary.

Boston University is about to establish a scientific department in the College of Liberal Arts, and has appointed in this department A. W. Weysse, A.B., Ph.D. (Harvard), now of the Massachusetts Institute of Technology, to be assistant professor of biology, and L. G. Newell, A.M. (Brown), Ph.D. (Johns Hopkins), now of the State Normal School at Lowell, to be assistant professor of chemistry.

George M. Stratton, A.B. (California), Ph.D. (Leipzig), associate professor of psychology in the University of California, has been appointed professor of experimental psychology in the Johns Hopkins University.

Dr. R. G. Van Name has been appointed to an instructorship in chemistry at Yale University.

Professor William O. Emery has been appointed head of the chemical department and director of the chemical laboratory in the New Mexico State School of Mines. Dr. Emery was for ten years instructor and docent in the Universities of Berlin and Bonn. He was later connected with the University of Chicago, and professor in Wabash College.

Professor H. E. Crampton, of Columbia University, will take charge of the work in embryology at the biological laboratory at Cold Spring Harbor.

Dr. Rothpletz has been made professor of geology and paleontology at the university of Munich, in the room of the late Professor von Zittell.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 22, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## THE GROWTH AND FUNCTION OF THE MODERN LABORATORY.*

IT is opportune, upon an occasion such as this, when we are assembled at the dedication of the newest of scientific laboratories, to consider for a moment the process of development by which they arrived at the state of efficiency of which this building is so striking an example. Then, too, it is of vital interest to those of us whose work lies in laboratories, and of much more than passing interest to every individual in the community, to have a clear idea as to what good purpose this and other similar institutions may be expected to serve, and how best they may accomplish that purpose.

The marvelous advances of the past seventy-five years are well enough known to us all, and never fail to fill us with astonishment when we stop to think about them. Discoveries and applications of discoveries have followed each other with such rapidity that our sense of appreciation is in a measure blunted, and we fail to realize adequately what they mean to each one of us, in comfort and convenience. No sooner did we become accustomed to the fact that we could telegraph across the ocean, than we were occupied in wondering at our ability to telephone to any one within a radius of several miles, and the great present extension of this radius, and the high probability that we shall be able to talk across the Atlantic in a very few years, does not meet appreciation to correspond

* An address read at the dedication exercises of Palmer Hall, Colorado College, February 22, 1904.

to the difficulties which have been overcome. Gas lighting was not universally introduced before electric lighting reached such a high degree of development that many belated country towns skipped a cog and put in dynamos. If this possibility had been suggested fifteen or twenty years ago, it would have been greeted with incredulous smiles. Only an insignificant minority of us had actually looked through a fluoroscope and seen the bones of our own hands by means of Roentgen's rays, when Becquerel rays and all the various rays from radium intervened to confuse us with the very multitude of wonders. All these great advances have been made possible and have had their origin in laboratories and laboratory methods, so that it is but natural that laboratories themselves should have undergone equally rapid and radical changes.

Eighty years ago there was not, in any country, a single laboratory for the purpose of teaching chemistry. To be sure, the subject had been taught for many years, both abroad and here, by lectures which formed a recognized part of a medical education. At Harvard, Dr. Aaron Dexter was installed as professor of chemistry and materia medica in 1783. In 1791, Major William Erving died, and in his will declared that, "Being unwilling to pass through existence without profiting the community, it is my will and pleasure that a sum of money, not less than one thousand pounds, be paid, as soon as it conveniently can be after my decease, into the hands of the overseers and corporation of Harvard College, for the sole use and purpose of enlarging the salary of the professor of chemistry, who is to receive the annual interest of it." If this quotation adorns my tale, it also points a moral by no means out of date. The Erving professor of chemistry and materia medica, in the year 1811, was drawing the munificent salary of $700 annually.

We get a realistic picture of the facilities for teaching chemistry at that time, from the early history of Columbia, in the first volume of 'Universities and their Sons.' It appears that in 1792 a committee of the trustees of that institution concluded that they needed 'a professor of natural history, chemistry, agriculture and other arts depending thereon.' They further defined his duties in this wise: "The schedule or sketch of this professorship to comprehend the philosophical doctrines of chemistry and natural history under the following heads: (1) geology, or the natural and chemical history of the earth; (2) meteorology, or the natural and chemical history of the atmosphere; (3) hydrology, or the natural and chemical history of waters; (4) mineralogy, or the natural and chemical history of fossil substances; (5) botany, or the natural and chemical history of plants; (6) zoology, or the natural and chemical history of animals."

This program would be sufficient to stagger most of us, and so it is with some relief that we learn a little farther on that the college had facilities for the work, which they described as 'a handsome chemical apparatus * * * and a considerable collection of fossils.' But any growing confidence in the desirability of the position is shattered when we learn that in 1814 the trustees memorialized the legislature, and amongst numerous complaints detailed, the following is not the least grievous. They say, 'they have found it due to the state of science and to public opinion to institute a professorship of chemistry as a part of the academic course, and have appointed a professor without being able to give him any compensation'!

While all teaching was done by means of lectures alone, laboratories did of course exist, though we might well hesitate before

granting them the dignity of that title. They were private affairs, belonging either to rich individuals with a taste for natural philosophy, or to apothecaries, or to some of these lecturers, who provided themselves somehow or other, in spite of obstacles nearly insurmountable, at their own cost, with the means of experimenting. There is a minute description of a laboratory, evidently just such as it should be, in Dr. Ure's 'Dictionary of Chemistry,' the American edition of which appeared in 1821. A few sentences will suffice to give us a picture of the laboratory of that day. Dr. Ure tells us that, 'Many people think that a laboratory level with the ground is most convenient * * * but it is subject to very great inconvenience from moisture.' "In such a place, the inscriptions fall off or are effaced; the bellows rot; the metals rust; the furnaces molder, and everything almost spoils." "In the laboratory a chimney ought to be constructed, so high that a person may easily stand under it, and as extensive as is possible; that is, from one wall to another." "As charcoal only is burnt under this chimney, no soot is collected in it; and, therefore, it need not be so wide as to allow a chimney-sweeper to pass up into it." "Under the chimney, at a convenient height, must be a row of hooks driven into the back and side walls; upon which are to be hung small shovels; iron pans; tongs; straight, crooked and circular pincers; pokers; iron rods, and other utensils for disposing the fuel and managing the crucibles." "To the walls of the laboratory ought to be fastened shelves of different breadths and heights; or these shelves may be suspended by hooks." "The shelves are to contain glass vessels, and the products of operations, and ought to be in as great a number as is possible." "In a laboratory where many experiments are made there can not be too many shelves." The detailed description which he gives as to the necessary equipment, not forgetting even 'a glue pot, with its little brush,' and 'a good steel for striking fire,' is both amusing and interesting, but these quotations are enough to produce a fairly precise picture of a 'modern' chemical laboratory of 1820.

We have another, and much more interesting and historically valuable description of one of these old laboratories, as it was just before the marvelous rush forward began. You will remember that Wöhler, forever famous as the first to break down the apparently impenetrable barrier between inorganic substances and those formed through processes of life and growth, by making urea in the laboratory, went, in 1823, to study and work with the yet more famous Berzelius. He has left us a description of the laboratory, which was in Berzelius's own house. He says the laboratory was 'close to the living rooms and consisted of two ordinary rooms, most simply fitted up; they contained no furnace nor draft, no water nor gas pipes.' "In one of the rooms stood two common pine wood-working tables; Berzelius had his working place at one, I mine, at the other." "On the walls were some cupboards containing reagents, of which there was no excessive variety, for I had to send to Lübeck for some potassium ferrocyanide when I needed it in my experiments." "The arrangement for washing apparatus consisted of a stone water jar, with a stopcock and slop jar beneath it." "The balances and other instruments were in the second room, and near by there was also a little workshop with a turning lathe." "In the kitchen, where the austere old Anna, cook and factotum to the northern master who was then a bachelor, prepared the meals, there stood a little furnace and the sand-bath which was always kept hot." And yet in these surroundings and with these appliances Berzelius discovered sev-

eral elements, isolated others for the first time, determined a great number of atomic (or, as we prefer to call them, combining) weights, worked out numerous new analytical methods, and did much of great importance in organic chemistry. You probably recollect that Sir John Herschel, while at the university in 1819, for lack of a better place, converted his sleeping room into a laboratory, discovered the solvent action of sodium thiosulphate, so important in photographic processes, and had endless trouble with the chambermaid and his landlady because of the mess he made.

The leading scientific men of those days were as well aware of the necessity of laboratory teaching to convey a proper knowledge of the subject as we are ourselves, and repeated efforts were made to induce college and university authorities to recognize this need. But insuperable difficulties were met, and not the least of these was the opposition of those engaged in teaching the classics. These ultra conservatives, to use no harsher term, were not even willing to grant that chemistry ranked as a science, and vigorously resisted attempts to introduce it as a regular study. To Liebig, at Giessen, belongs the credit of making the first successful breach through these prejudices, and establishing the first chemical laboratory ever opened to students in a university. This was soon after 1824, the year in which he began his work at Giessen. This famous laboratory of his was small and had a precarious existence at first. Ten years after its opening Liebig, in a bitter letter to the chancellor of the university who controlled the funds, complained that he had been given nothing but four bare walls, and no money whatever for equipment or running expenses. Every piece of apparatus, and every chemical in it, he had bought and paid for out of his small salary. His patience was exhausted and he threatened to resign, and to make known the treatment he had received in justification of his resignation. In response to this, and stirred by the fear of the scandal that exposure would cause, the chancellor provided the minimum amount of money necessary to appease and retain Liebig. But students had flocked to Giessen from every civilized country, and returned inspired and eager to follow Liebig's example in their own homes. Laboratories, and courses in chemistry, modeled on Liebig's, sprang up in too rapid succession to follow. We may, however, describe one or two of the beginnings in our own country.

Chemistry was taught in the laboratory in the medical department of Harvard, in the city of Boston, at an early date, and in 1846 a new medical school was built, the basement of which was devoted to a chemical laboratory capable of accommodating 138 students. In the academic department recognition of the subject was slower. Professor Josiah P. Cook, Erving professor of chemistry, who died only a few years ago, succeeded in getting a small laboratory fitted up in the basement of the main university building in 1851, and President Eliot was the first student to take advantage of the opportunity offered.

At Yale Professor Benjamin Silliman and his son established a laboratory of analytical chemistry and mineralogy, as a private venture, and it became of sufficient importance to be incorporated as part of the university in 1847. This proved to be the nucleus from which sprang the present Sheffield Scientific School.

The University of Michigan is generally recognized as having always set the pace for other state universities, and maintained its leadership in this department also, by being the first of them to introduce the laboratory method in teaching. Three years after Professor Cooke had begun educating President Eliot, Dr. Douglas, of

the University of Michigan, was instructing a class in qualitative analysis, in a small room of the medical building, now utilized as a preparation room for lectures. A building exclusively for the teaching of chemistry was finished at a cost of $6,000, including the equipment, and was in use in 1856, or a year before Boylston Hall was opened at Harvard. In one of his reports, written as this laboratory was nearing completion, President Tappan says that it 'will unquestionably be unsurpassed by anything of the kind in our country.' Every few years the demands for more space became so urgent and so obvious that an ell was added, or a cellar was excavated, until, in that huge labyrinth, whose very floors are worn through by constant use, as it stands to-day, one may study the development of laboratories, as the geologist studies the development of the earth, by an inspection of the strata. It is worthy of remark that we have the promise of our board of regents that the next large building which they undertake shall be a new chemical laboratory.

Turning now from this review of by-gone times to the present, we may well marvel that such a complete revolution of conditions could occur in fifty years. It would be harder to find a university without moderately good laboratories to-day than it was to find one with them in 1850. And they are increasing in numbers and size, through the munificence of individuals and of legislatures and governments, at a surprising rate. These modern laboratories need no description, for we have the actual model here before us.

At no other period in the history of the world has so much money been available for the teaching and the advancement of science. The great endowments and bequests of recent years, as represented by the Carnegie Institution, Leland Stanford University and the University of Chicago, to mention only three, are as well known to you as to me. I had the curiosity to look through Science, for the year 1903, and to add together all the sums recorded there as actually given during that year to colleges and universities, excluding items that might be simply newspaper rumors. It was surprising to find that they footed up to $15,241,533. Add to this Carnegie's ten millions to the Scottish universities, and the McKay fortune, variously estimated at from four to twenty millions, which is to go to Harvard eventually, and the total is truly princely.

Such figures lead very naturally to the question: Have the universities deserved such sums, from the point of view of what they have accomplished in the past, and can they possibly require more than they now have? Any one who has had to do with a university can answer in the affirmative to each of these questions without hesitation and without qualification. It is my intention to prove that all the money ever given to the cause of education and science does not equal a fraction of one per cent. of the returns made by them, and at the same time to prove that no better, nor more surely profitable investment for money is to be found, than in increasing these endowments and bequests many fold. In the first place, we should realize that most of these gifts are principal sums, and the interest only is available, which puts a different aspect on the question at once. Furthermore, we must also realize that most of the bequests are for specific purposes, and very generally are so hampered with restrictions that they can not be applied where they will do the most good. An illustration of the way in which such conditions may work out in the course of time is the bequest of a well-meaning clergyman made more than a century ago to Harvard, the interest of which was to support a preacher among the Indians.

He evidently intended to protect home industries, but the bursar's checks have to travel a long way now. It is not in the least essential to my argument to diminish the total amount to be accounted for, rather let it be imagined that all the money now invested in the buildings and equipments of our universities has completely vanished, and still we shall be able to find hundreds of dollars' worth for every dollar expended on laboratories or scientific work.

The duties or functions of laboratories have always been, and properly are, twofold, to teach and to advance knowledge, Some have been devoted exclusively to teaching and others exclusively to research, but the best balanced are undoubtedly those which take up the full burden and do both. The results along either line are ample to justify my contention. Consider what some of the discoveries made in laboratories have been, and what they have meant to civilization. It is not my intention to weary you with a list of several hundred valuable discoveries, but rather to call your attention to certain characteristics possessed by them, not often enough emphasized. First and foremost among these characteristics must stand the fact that, with scarcely an exception, those discoveries which have been of the greatest material benefit to society have been the results of disinterested research in pure science, complete and unconditional gifts to the whole world. Brandt received nothing for his discovery of phosphorus in 1669, but after the lapse of a century and a half it gave us those simple but indispensable conveniences, matches. Valerius Cordus, when he first made ether in 1540, and Guthrie and Liebig, when they discovered chloroform in 1831, got no rewards for those godsends they were giving to suffering humanity. Such examples might be multiplied, and they would all have that characteristic—they have been free gifts to mankind.

To my mind, at least, another class of results is even more important than such as these. I refer to the great and fundamental laws, principles and theories of our sciences. For while the chance of financial reward to the discoverer is practically eliminated, they alone make possible the far-reaching applications of science, and assure us of a continuation of our advance, by furnishing the firm working bases. Who can estimate the value of Dalton's atomic theory, and all the patient and painstaking work involved in the determination of the atomic weights, for the manifold chemical and allied industries, and through them for us all? How much was Faraday's discovery and study of the phenomena of electrical induction worth, bearing in mind that it made possible our dynamos and motors? Scarcely an electrical measurement is made but what Ohm's law is used in the calculation, yet how many of us have stopped to think what an immense saving of time and money is effected daily by that simple formulation of his? But once more there is danger of becoming prolix with such a vista of apt examples opened out before me.

The reproach is sometimes made by those who know little of science, that much of the research work done is useless from the practical point of view, and results only in scientific curiosities. Such curiosities were cerium and thorium at one time, but now we have the Welsbach gas mantle. The scientific curiosity of to-day is very apt to become the household necessity of to-morrow. A friend once watched Faraday in his laboratory for a while, and then asked him of what use such work could be. Faraday immediately replied with the question, 'Of what use is a baby?'

It is not impossible that the objection might be raised that many of the newest

inventions at least are patented, and that then tribute is levied in the shape of royalties. This is true, and it is somewhat unfortunate, also, that in the majority of instances the wrong man gets the royalty. A law of nature is not patentable, but the application is, and so it comes about that the real discoverer, retiring and absorbed in his science as he must be to produce his intellectual marvels, is overlooked by the public, overshadowed by some one who happens to find a patentable application of a discovery in which he took no part. It is worth pondering a moment that practical and patentable are not synonymous terms. It is far from my intention to imply that the patentee does not deserve his royalties; he unquestionably does, and fills an important and necessary function in the social economy.

In any case, such tribute as is levied in this way is but a small fraction of the worth of the invention, and the public always gets a good bargain. The actual value, in dollars and cents, of that portion of the fruits of scientific labor which is given for nothing is hard to estimate, but perhaps we may get a notion of it by analyzing one specific case. Suppose some one unprincipled individual obtained an absolute and unquestioned monopoly of all telephones to-morrow. Suppose him to be under no legal restraint, and that he proceeded to squeeze every user of a telephone as hard as possible. It is safe to predict that single business firms would pay him thousands of dollars, rather than lose that indispensable adjunct to their facilities for carrying on their work. Add together all that he could possibly get in this way from all over the world, and subtract from this total the amount now being paid, and we shall get the value of one little gift of science to mankind. Is it extravagant to estimate this one item, as exceeding the total cost of all educational institutions since the dawn of civilization?

Let me put the question in another form: What is the total value of all the time saved by telegrams and by our present means of transportation? And again, how much would you pay for enough antitoxin to save your child from death by diphtheria? These things are inestimable, and my original statement stands proved.

Professor Dewar drew a particularly illuminating comparison about a year ago. He wished 'to find out exactly what some definite quantity of scientific achievement has cost in hard cash.' He found that 'the total cost of a century of scientific work in the laboratories of the Royal Institution, together with public demonstrations,' was £119,800. This is the price which was paid for all the achievements of Young, Davy, Faraday, Tyndall and Dewar himself. No wonder that Dewar reaches the conclusion 'that the exceptional man is about the cheapest of natural products.' We may sum all this up by saying that it is impossible to fix the value of the results obtained by research workers in laboratories, for the simple reason that they have been the *creators of nearly everything that makes money worth having.*

And so far we have touched upon only one of the two functions of our universities and laboratories. The laboratory of yesterday taught the engineer and the doctor of to-day, and the laboratory of to-day is training the discoverer and inventor of to-morrow. The value of the educational work done is so generally recognized and attested by the donations of private citizens, and the constantly increasing grants made by far-sighted legislative bodies, that it requires no elaboration. It admits of no argument that the total knowledge of the human race is worth more than all the money in the world. Our constant strides to higher and higher planes of enlighten-

ment which were never so rapid as now, and which seem to be subject to a law of acceleration similiar to that of gravitation, are due, we are all of us ready to acknowledge, more than to any other influence, to the constantly increasing numbers who obtain the advantage of superior, of college and of university educations. Statistics taken from biographical dictionaries for a definite period show that one out of every 250 of those with college training do something worth recording in such a book, while of those without this training the proportion is about one in 10,000.

We are too apt to fix our attention exclusively upon the exceptions, upon those brilliant individuals who make their marks in the world, and to withhold deserved appreciation from that much larger number of what we may call the average, the mediocre. Yet these latter do the most of the world's work, and in the aggregate their output is in excess of that of the exceptional individuals. Upon their ability to appreciate and to utilize the discoveries and the methods, found and described by the leaders, depends our advance as a race. The most useful and effective of machines is practically useless and ineffective, if only one man in the world has the knowledge and ability to run it. In this scientific and mechanical age of ours, where specialization has been carried so far in every branch of industry and every occupation in life, there is an ever-increasing necessity for more and better preliminary training, before a man is competent to control and govern the more and more complicated conditions. Upon our laboratories devolves the task of disseminating a general knowledge, broad enough and widely enough distributed, to ensure the recognition and immediate utilization of the great improvements made possible by scientific methods, and also of turning out ever larger numbers of men, thoroughly equipped to cope with the industrial processes as they stand to-day, and with the intelligence to adopt improvements as they appear.

Our manufacturers are rapidly waking to the fact that it is sound business sense, and brings big returns, to fit up private laboratories of their own and employ well-trained scientists to study and to improve their processes. It is strange that, leaders as we are in so many particulars, we should be so far behind the Germans in this respect. They learned this lesson years ago, and to it owe their leadership of the world in nearly all branches of chemistry. A forcible comparison between German and British chemical industries is drawn by Professor Dewar in his address to which I have already had occasion to refer. You are doubtless familiar with it, but a few sample statistics will certainly bear repetition. From details regarding 633 German and 500 British works-chemists, he finds that 69 per cent. of the Germans hold the degree of doctor of philosophy, and 84 per cent. have received thorough systematic training, while 31 per cent. is the outside figure for the thoroughly trained among the British works-chemists. He next finds that the German chemical industries do a business of over $250,000,000 yearly, and that they are largely based on English discoveries which were not appreciated nor developed, in spite of the abundance and cheapness of raw material close at hand. We sometimes forget, in the multiplicity of his accomplishments, that Faraday discovered benzene. He gives figures to show the progress of one of the German firms, that of Friedrich Bayer & Co., which employed one hundred and nineteen workmen in 1875. He says: "The number has more than doubled itself every five years, and in May, 1902, the firm employed five thousand workmen, one hundred and sixty chemists, two hundred and sixty engineers and

mechanics, and six hundred and eighty clerks.'' ''For many years past it has regularly paid eighteen per cent. on the ordinary shares, which in 1902 rose to 20 per cent.; and in addition, in common with other and even larger concerns in the same industry, has paid out of profits for immense extensions usually charged to capital account.'' ''There is one of these factories, the works and plant of which stand in the books at $7,500,000, while the money actually sunk in them approaches $25,000,000.'' Such statistics are producing their inevitable effect, and the demand from our industries for graduates capable, not merely of carrying out qualitative and quantitative analyses, but with a training fitting them to study and improve processes, and develop new ones to meet new wants, is already much in excess of the supply, and will grow larger and more imperative. Only a short time ago a recent graduate was offered a position in our university at $1,500, whereupon his employer raised his salary to $3,000, and wrote to the university jocularly suggesting that it increase its bid to that amount, and he would raise it again.

To meet these demands, as well as the just expectation of society, that laboratories and scientific workers shall continue their free gifts to all, means that our laboratories must not merely keep abreast of the times, they must keep ahead of them. To do this they must have apparatus and equipments which grow more elaborate and more costly each year.

Thinking of the astonishing results obtained by the pioneers of chemistry and of physics, as compared with the extreme simplicity and the paucity of their instruments, it is natural that the first impulse should be to conclude that our modern laboratories are extravagant in their demands. But there is more sound truth than there is generally conceded to be in that time-honored jest about the young aspirant for scientific laurels who, after a long search through the archives of science, came back to his professor with the bitter complaint that 'all the easy things had been discovered already.' The domain of science is not exempt from the general law that the simplest and easiest is done first, and saying this should not be construed as detracting in the least from the fame of a Columbus of science who launched forth in the courage of his convictions, and after much hardship discovered a new world. The first comer had but to pick the plant nearest at hand to obtain a new specimen, and the roughest sketch of the coast line was a great contribution to knowledge. But think of the years of skilled labor, the reams of calculations, and the thousands of exquisitely made instruments that had to be employed before the government could issue those perfect charts of the waters surrounding our country. It was not so very many years ago that gold and silver could be found on and near the surface hereabouts, but that is not now the case. It is said, and it is no doubt true, that the treasures of the Rocky Mountains have been no more than scratched as yet. These scratches are on the surface, and the easiest ones to make, and you must dig more mines and deeper each year. Once a pan and a stream of water were the essentials to wash out a fortune; now gold-bearing quartz is crushed in the stamp mills, and is treated by the cyanide process. Your modern gold mine requires an initial expenditure of one or two hundred thousand dollars before it begins to pay dividends. The analogy is perfect. The prospector's pan of yesterday is to the installation of to-day as the laboratory needs of yesterday are to the laboratory needs of to-day.

Please notice it pays well to dig deeper, to crush the ore, to concentrate it and to send it to a smelter. The processes are

longer and more expensive, but the investment is still returned with high interest. The problems to be met have been growing more difficult, but they have been met, and successfully solved, by those with laboratory training, or by those who have profited by the knowledge of the facts dug out in the laboratory. More problems, and more difficult ones, will arise, and they in their turn will be solved, if laboratories and their equipments are maintained at their highest degree of efficiency by liberal endowments and grants. But it would be as absurd to expect our men of science to cope with the complex questions of the present and the immediate future with antiquated utensils, as it would be to send our sailors off in the wooden ships of the war of 1812 to grapple with the Japanese navy.

The idea that a given sum will build and equip a laboratory, and that once set going it will run itself and require nothing more than occasional small sums to replace loss by breakage and the like is a pernicious fallacy. New methods, requiring new or improved instruments, appear each year, and these instruments must be had, if there is to be any pushing forward into the unknown in the branch to which they are adapted. It is a noteworthy fact that, crude as the materials of the early experimenters were, they were the best for their purpose to be had in the world of that time. Faraday insulated his wires with bits of string and old calico, but no one had better insulated wire. Davy obtained sodium and potassium by electrolysis, but he had the biggest and best galvanic battery in existence at the time. It would have been practically impossible to discover Hertzian waves, or Röntgen rays, or wireless telegraphy, without the best of induction coils. And so we might continue *ad infinitum.* It is clearly impossible for one laboratory to have the best of everything, but it is equally clear that each laboratory should have a fairly representative equipment on all general lines, primarily for teaching purposes, and should have an outfit equal to the very best for one or two topics. These topics should be different in different places, and may often be adapted to special localities; they should be chosen by the members of the instructing staff according to their individual aptitudes and interests.

Our laboratories have overwhelmingly justified their cost by their past history, and are justified in making greater demands than ever, by the importance of the functions which they fulfil.

It is to be hoped that philanthropists will be still more liberal than they have been, and that the people will tax themselves more than they ever have, through their legislatures, to give to all schools, colleges and universities. Such money is the fire insurance and the life insurance of society as a whole, guaranteeing the maintenance of law and order, and the ability of the next generation to support the burden of advancing civilization, when its turn comes.

S. Lawrence Bigelow.
University of Michigan.

## *IS THE COURSE FOR COLLEGE ENTRANCE REQUIREMENTS BEST FOR THOSE WHO GO NO FURTHER?**

The question is an old one. Is there conflict or harmony of interests between secondary and higher education? Should the high-school student be laying foundations for future study, or should he be doing work that is complete in itself, so far as it goes; or may he not secure a maximum of present utility while laying satisfactory foundations for future studies? I should prefer to discuss the question the other

* Address delivered before the Biological Section of the Central Association of Science and Mathematics Teachers in Chicago. General subject of the meeting: 'Essentials of a High-school Course in Biology.'

end about, for the need of the majority is the constant term involved—fairly constant, at least, since that need will change only with the slow alteration of environment—while the entrance requirement is a much more variable quantity. Let us ask then: Is not the course in biology that is best for the student who ends his studies with the high school a good and satisfactory preparation for college?

When the struggle for existence between subjects now contending for place in the school program shall have worked itself out we shall probably know better what is best for the majority 'who go no further.' Now we must needs exercise foresight, while hindsight will be much clearer. We may gain some hints of things to come by comparing the situation with respect to these newer subjects with the state of those that have reached the end of the struggle and established themselves. The subjects now universally conceded a place in the school program, such as reading, writing, arithmetic, spelling, grammar, geography, etc., stand in marked contrast with some of the newer subjects as respects articulation. These older subjects are orderly, consecutive and complete in themselves: the student drops any of them anywhere without loss—with only gain for what he has had—even though, for example, he stop between short and long division. The list of such studies is longer than it once was; and it may well be that other subjects will come to take their places as essentials when they demonstrate the same degree of educational efficiency and adjust themselves in orderly and progressive sequence.

It must be admitted at once that at present there is no biological program. Studies of living things begin in some places in the kindergarten; in some, in the grades; in some, in the high school; in some, in the college; and in some they do not begin at all. In some they are continuous; in some, interrupted; in most there is little effort at articulation. The unsettled state of our subject is remarkably evidenced in three different ways: (1) The rapid shifts of emphasis as to what shall be taught, (2) the diversity of high school text-books and (3) the indefiniteness of the college entrance requirements.

1. The shifts of emphasis are due chiefly to the fact that most of our nature study has been handed down from above, instead of growing up from below. High-school and normal-school zoology and botany have too often been handed down ready-made by university professors. In my own high school days it was all systems of classification they were handing down. In my college days, it was all anatomy; now it is nearly all ecology. It is now hardly more than a decade since many teachers, newly returned from college or normal school, where their zoological training had consisted in dissecting a cat, were trying the same course they had taken, without dilution or alteration, on the little innocent children. This did not last long, however, for the body politic is more or less resistant to the germs of educational diseases; but it lasted long enough to leave in the mind of the public an unsavory impression of zoology, not yet entirely lived down.

2. The diversity of text-books is very great, in both subject matter and method. Some of the recent ones are all reading—storiettes about animals and plants; some are all dissecting; some are all keys and descriptions for determining of forms; some are all physiology; some are all experimentation; some are all ecology, and some are admixtures of some or all of these things. This diversity is the result of trying to fit one of the most extensive subjects with which the human mind has to deal into one of the smallest niches in the high-school program. Each author appears to have included what he has been able to get

in satisfactorily, and to have lopped off the remainder. And if any one wishes to learn whether these different things are considered pedagogical equivalents, just let him read the prefaces of these books!

3. The usual college entrance requirement in biology at present is 'one year of *some laboratory science'!* Surely this is broad enough to meet the demands of pioneer conditions.

What we have settled among ourselves appears to be that it is worth while to study living things at first hand. Since we may not do more, let us congratulate ourselves that we have progressed thus far, and pull ourselves together for a new start.

What of biology shall be taught in the high school? Is not this a pedagogic question? Yes, as are all questions of fitting subject matter to the receptivity of the developing mind. Is it not also a scientific question? Yes, as science must adjudge the worth of the subject matter. But biological education is more than either pedagogy or science—more than details of instruction, or biological phenomena. It must be in the long run orderly and progressive development toward fitness for the activities of life. The place and portion of biology in the curriculum will not be determined by the dictum of the colleges, or the preferences of the schools, or the methodology of philosophers, but by the operation of natural laws chiefly, the law of natural selection. If biological teaching survive in the high school or anywhere else, it will survive by reason of its fitness as a part in the preparation for life. Therefore, we must never lose sight of the peculiarly intimate relations biology bears to human life. On the practical side, what other subject can compare with one whose chief practical applications are:

First, *living in this world*—hygiene, in its very broadest application, including all personal control over the welfare of body and mind.

Second, *getting the materials of livelihood*—agriculture in its very broadest application, including all that relates to our dependence on the organic life of the world.

Third, *medicine*—the healing art, sometimes mistakenly called the principal application of biology.

I will not mention the multitude of newer applications arising on every hand and making ever-increasing demands for knowledge of the facts and principles of life.

Out of these relations there grow, I think, four incontestable reasons why every one should study biology:

1. To know animals and plants better. We have to deal with them in life. We should know how to protect our friends and combat our enemies among them, and to appreciate the place in the world of all of them. The ancient poetic vision of creation ends with the statement concerning every living thing, 'To you it shall be for meat.'

2. To know our environment better, not alone its economic, but also its esthetic side: to know the charm of life, its wonderful beauty of color and form, its grace of motion, its adaptation to place and function. Here poets and naturalists and artists alike have found themes since the beginning of civilization.

3. To know ourselves better—possessors of animal bodies, that are subject to the same laws, that are moved by the same instincts and that feel the same necessities as other animal bodies, and on the normal healthful activity of which all our possibilities of happiness and usefulness in life depend.

4. To know something of the development of life in the world, and thus to get acquainted with those general develop-

mental principles which underlie modern methods of study in all departments of knowledge: which were first fully developed and are still best exemplified in the field of biology.

Now it seems to me that the consideration of these matters will help us to determine what are some of the things that should constitute part of the intellectual stock-in-trade of the average coming citizen, who will go no further in formal studies than the high school. I will venture to name seven phases of biology now more or less commonly studied, the value of which as parts of a high-school course I consider already demonstrated:

1. Elementary classification—the systematizing of the random observations of nature study in the grades and of contact in life with living things. It need not be very extensive, and might about as well use common names as technical; but it should be a genuine gathering together of known forms into natural groups and a fixing of such groups by names. It will not matter much if, through lack of insight, some forms occasionally get into the wrong group, for such slips still occur with accomplished specialists. Classification naturally and properly follows hard upon the heels of observation, and only goes astray when it runs on ahead. Classification furnishes the handles by which we move all our intellectual luggage. Let us have just enough for our needs.

A modicum of collection making may be allowed here; if fondness is shown for it, it may even be encouraged in individuals and outside the allotted program; and the use of keys analytical should certainly be taught by a little practice. How many naturalists have begun their careers by making collections, and how great and how good is the influence in the present day of the ever-increasing number of manuals and hand-books that are spreading abroad the knowledge of living things.

For many years I have heard professional botanists railing against the old-fashioned course in flower analysis; but I want to testify that I once had such a course, and I have never had a better course in botany or in any other subject whatsoever. It was all nature study of the very best sort and full of the delights of discovery; and the worst that could be said of it is that it was one-sided and incomplete—not a very bad charge, considering the limitations of our knowledge and the immensity of the field.

2. *The study of living nature;* whether we call it old-fashioned natural history or new-fashioned ecology does not matter. In either case we mean the study of plants and animals in relation to their environment. This is the study of the phenomena of fitness. It is simple enough to interest the youngest mind, and profound enough to have furnished the basis for our most important biological generalizations.

It should never be merely reading and talking about remote and wonderfully adapted creatures, but instead, detailed and practical studies of the adaptation of common plants and animals. For instance, protective coloration should not begin with the kallima butterfly, but with the grasshoppers and moths of the dooryard, and results should be secured that are as definite as those of the study of the anatomy of the grasshopper. Merely noting resemblance is not studying it. The pupil should record comparatively the details of the resemblance, whether general or specific, whether in form or in color, how brought about, to what particular environment best fitted, the relative perfection of it, the differences in different animals, etc.

With all the emphasis that is placed on ecology in many recent high-school books,

it is astonishing how little attention is given to pointing a way for the inductive study of ecology on the part of students. It seems hardly to be recognized yet that ecological types are as common and as widely distributed as are morphological types, and that their study may be made to yield equally definite results. It is perhaps excusable, therefore, when teachers read the interesting discussions presented in these books, and instead of applying inductive methods to the study of the same subjects, revert to anatomy for pedagogic results, or else lapse into text-book and recitation methods; but it is still painful, and lamentable, and altogether unnecessary.

There are values of one sort growing out of the intensive laboratory study of a few types; these values have long been recognized. There are other and equal values growing out of the observation of nature in a great variety of forms and relations. These latter values a good ecological program will enable us to realize.

3. A few practical, individual exercises in methods of economic procedure, based on and necessitating a somewhat intimate knowledge of structure, functions and habits of important animals and plants and their enemies—not the mere entertaining observations of nature study in the grades, such as feeding a frog on cut worms: such things should have been done already: but simple practical economic experiments under natural conditions, with the fundamental biologic facts and the desired practical results kept clearly in mind. I would include this, not as a sop to 'practical folk,' though it would in many cases make for solidarity between school and home, but because it is justified on good pedagogic grounds. The youthful mind is practical. Interest is sharpened, and the details of scientific knowledge are better appreciated when things taught are recognized as constituting useful knowledge.

4. The study of reproduction and development. This is in a sense half of biology; for the place of a species on the earth is maintained if it (1) get a living and (2) reproduce its kind. I deem the few local and sporadic attempts that have been made to exclude all consideration for reproduction from the high-school course as an unworthy concession to near-sighted pseudo-pedagogy. For my own part I have always deemed it a privilege to bring to young people some real information as a basis for sane consideration of this much abused subject. Aside from the paramount importance of the subject biologically, I should regret to see this (oftentimes the only) gateway of practical knowledge shut before them. Furthermore, I am inclined to think that the teaching of these matters is needed as an antidote to the smut of the ancient classics and of English history. I judge the results of the teaching of this subject not by the attitude of the student when it is first broached, but by his attitude when the study is done.

Life history studies, it seems to me, are worthy of the greater part of the time spent on these matters, and to these may be added a modicum of embryology of the most elementary sort, preferably, for us in the interior, on the eggs of some amphibian, and a brief, clear and straightforward presentation of the essential features of reproduction, illustrated in the lower forms of animal life and in plants.

5. Physiology, especially the physiology of organs. This already holds a secure and well-merited place; so I but mention it in passing.

6. The study of structure. Anatomy, for a considerable period held the field, almost to the exclusion of every other phase of biological study. But with recognition of the fact that the educational values of biology are far from being confined to the dissecting table, some of the anatomical

work has had to go. We must forever give over the attempt to illustrate the whole gamut of evolutionary changes in a series of types. But we may retain enough of anatomy to be comparative, enough to illustrate kinship clearly, enough to illustrate differentiation, homology, analogy, etc. And may we have this with a maximum of fact and a minimum of terminology! Let us give preference to external anatomy and the study of whole micro-organisms, over internal anatomy and microtome sections. Other things being equal, let us give preference to the sort of work that the interested student may continue after he has left the laboratory behind.

7. Lastly, there should be included the more general conceptions that have grown out of the consideration of biological facts and phenomena and that have taken their places in the world of thought. I mean that there should be considered evolution, with practical studies in the survival of the fittest; the biogenetic law, with practical detailed study of some illustration of the correspondence between ontogeny and phylogeny, etc. These should be introduced because they can not in justice be withheld rather than because the majority go no further. I would have them introduced, also, because some, who are accustomed to get their basis for thinking by more roundabout methods, are still maintaining that biology is a purely observational subject. These all but universal principles the world owes chiefly to biology, and may rightly expect that teachers of biology will faithfully teach them and not withhold the indications of their wide applicability.

Let it be understood that these seven phases of the subject are not offered as a program; far from it. They are not topics for study, but matters to be emphasized in connection with any or all of the special topics to which they relate. I submit that among them is nothing that will not commend itself both for present value and for value as a basis for further progress in biology. I do not believe that any one is well equipped for intelligent participation in modern life if ignorant of these things. Without knowledge of them he will not know how to manage his own garden, his own table, his own appetites, his own emotions or his own thinking. It is, perhaps, true that there are those in circles of culture ready to apologize for the mispronunciation of a Latin phrase, or for the admission of not having read 'Ivanhoe' or even 'Treasure Island,' who would think nothing of it if one should call a whale a fish, or try to kill squashbugs by spraying them with Paris green, or ask what beetles turn into. Indeed, our leading newspapers still publish several times a year the circumstantial details of the case of one who, while drinking at a spring, swallowed tadpoles, and later coughed up frogs. But these things will not always be. On the other side of the matter, I would say for my own part that, so far as knowledge goes, it is some little real and first-hand knowledge of just these seven aspects of biology that I should like to have the high-school graduate equipped with when he presents himself for further work in college. It will have become sufficiently evident, in my opinion, that if the course that is best for life is not best for college entrance, it is so much the worse for the entrance requirement.

Even the few general topics I have named I would not at present *require* to be taught anywhere. I would merely recommend them. For while the science is so new, the field of possible studies so vast and the preparation of teachers so diverse, there is great danger that too much definiteness in a set program may curb initiative and curtail spontaneity. I would let the teachers of the present generation of pioneers do what they can do best to teach the rising generation to see and think, to

know and love their environment and to feel their kinship with the life of the world in body and spirit. Out of this work greater uniformity and better correlation will proceed naturally.

For pioneer conditions must pass. I once had a teacher of arithmetic who had a failing for the duodecimal system; that system had its beauties and its educational utilities also; but it has had to go. As it is no longer permissible to pasture one's cow on the common or to pick strawberries in any fence row, the time is sure to come when it will not be permissible for any teacher to teach what he pleases and when he pleases, according to the exigencies of his situation, the limitations of his knowledge or the prevailing fashion of his university. But it is this very freedom that allows the development of the possibilities of the subject; elimination will come later. May it be natural elimination, and not the forced kind that education suffers when 'men of violence take it by force.'

What is best for life is not completeness, for that is unattainable; not so much great knowledge, as a little knowledge rightly attained with an appetite for more. One danger in programs is that knowledge will be the chief end sought. But another and perhaps even greater danger is that they will be arranged from the standpoint of the specialist without due regard to the standpoint of the learner. How often has it been forgotten already that we had fingers before forceps, eyes before lenses, lenses before microscopes, jack-knives before scalpels, scalpels before microtomes. I have never found a truer statement of this matter than the following one from Professor J. Arthur Thompson: 'A circuitous course of study followed with natural eagerness will lead to better results than the most logical programs, if that take no root in the life of the student.'

I can not help feeling that science teaching, while it has earned its place, has fallen far short of accomplishing that public good for which we may reasonably hope: the diffusion of honesty and directness of method and respect for the simple truth; the abandonment of dogmatism and superstition. Perhaps it is because of the essential conservatism of human nature; perhaps it is because this teaching starts too late and finds scant lodgment in soil already stocked with the notions of an unscientific age; perhaps it is because that teaching is not yet direct and forceful enough to take hold upon the life and to touch the springs of conduct. But ultimate failure in these respects would rest especially upon biology, because of the intimate relations it bears to the life of the people.

James G. Needham.

## *SCIENTIFIC BOOKS.*

### REPORTS OF THE BELGIAN ANTARCTIC EXPEDITION.

*Résultats du Voyage du S. Y. Belgica, en 1897–8–9, sous le commandement de A. de Gerlache de Gomery.* Rapports Scientifiques, publiés aux frais du Gouvernement Belge, sous la direction de la Commission de la Belgica. Anvers, J. E. Buschmann. 1901 (et seq.). 4to, with plates and text-figures.

After the return of the Antarctic expedition on the Belgica, in December, 1899, by royal mandate a commission was appointed under the presidency of General Brialmont to supervise the publication of the scientific results. It is proposed to issue these in ten quarto volumes, the edition to be of 500 copies, exclusive of separate copies of the several papers, which, being issued with individual pagination, dates and covers, may appear as promptly as possible after preparation; the assembling into volumes being a subsequent arrangement.

Quite a number of these papers have already appeared, so that it seems desirable to give our readers some idea of what has been accomplished, although considerations of space will restrict our comment to the utmost limit of brevity on the present occasion. In a gen-

eral way it may be said that the manner in which the several papers are printed and illustrated is most satisfactory. The extremely barren nature of the region in which the party explored, renders many of the papers very short, but the possession of any well-founded results from this inhospitable region is a boon for which we are permanently indebted to the heroism of the explorers and the liberality of the Belgian government.

The date of issue of the several parts, as noted on the second page of each memoir, being often different from that appearing on the cover, we have cited the former in the following synopsis of the parts which have, so far, reached us.

'Astronomie, Etude des chronométres'; I., Méthodes et conclusions. G. LECOINTE (62 pp., 5 pl., 1901). II., Journal (131 pp., 1 pl., 1901).

'Météorologie. Aurores Australes.' H. ARCTOWSKI (64 pp., 2 pl., 1901).

Sixty-one auroras were observed during thirteen months. The maximum frequency was near the equinoxes, the diurnal maximum between ten and eleven P.M. A 26-day period was also plainly marked. The general characteristics were remarkably similar to those of boreal auroras, notwithstanding the great difference of the surroundings. Particularly intense displays were usually coincident with similar displays recorded simultaneously in the arctic observatories, and were observed to coincide with the appearance of sunspots.

'La neige et la givre.' A. DOBROWOLSKI (19 pp., 1903).

This memoir is chiefly devoted to a study of the forms and structure of snowflakes and hailstones.

'Observations des nuages.' A. DOBROWOLSKI (158 pp., 1902).

The observations taken are minute and full, but were much interfered with during the winter months by fog.

Phénoménes optiques de l'Atmosphére.' H. ARCTOWSKI (47 pp., 1902).

A journal of the parhelia, paraselenia, phenomena of refraction, luminous clouds, etc.

'Océanographie. Rapport sur les densités de l'eau de mer.' H. ARCTOWSKI (22 pp., 1 pl., 1901).

'Détermination de la densité de l'eau de mer.' J. THOULET (29 pp., 1 pl., 1901).

A journal and discussion of the observations and a review of methods of observation in general.

'Botany. Lichens.' Ed. A. WAINO (46 pp., 4 pl., 1903).

Fifty-five Antarctic species were collected, of which 38 per cent. are also Arctic or north European, 53 per cent. new or endemic, and only 19 per cent. common to the Magellanic region or South America, a somewhat unexpected conclusion.

'Mousses.' J. CARDOT (48 pp., 14 pl.) and 'Hépatiques.' F. STEPHANI (6 pp., 1901).

Cardot gives a general review of Magellanic bryology which will be most useful for students of mosses. A second section of the memoir is devoted to the Antarctic mosses. Many of these are finely developed, yet all except two were found to be absolutely sterile, and it is probable that fruit is produced in this region only under exceptional conditions. The species are usually associated, apparently for protection. The three endemic liverworts hide among the mosses. Twenty-seven species of mosses were noticed, of which fifteen are new. Nine of the known species are common to the Arctic regions and the new forms are generally closely related to analogous Arctic species. There is very little in common between the Magellanic and Antarctic mosses, the latter much more nearly resemble those of the boreal flora. This relationship is curiously opposed to the conditions which appear in the fauna, which has hardly any trace of bipolarity. There is in the Antarctic only one phanerogam, a grass, *Aira antarctica,* which has been found in widely separated localities.

'Zoologie. Spongiares.' E. TOPSENT (pp. 54, 6 pl., 1901).

Twenty-six species were obtained in Antarctic waters, eight monaxonids and five hexactinellids, are new. There is no indication of bipolarity in the sponge fauna, which extends to the southernmost position attained.

'Actiniares.' O. Carlgren (pp. 7, 1 pl., 1903).

'Madréporaires.' E. von Marenzeller (pp. 8, 1 pl.).

*Caryophyllia* was obtained in latitude 71° 09′ S., *Desmophyllum* in 71° 18′, and a new species, *Errina gracilis,* in 71° 19′. The '*Edwardsia*' stages of actinians were obtained in the tow net as far south as 71° 15′, and are described and figured.

'Seesterne.' H. Ludwig (pp. 72, 7 pl., 1903). A detailed account of the starfishes, with much anatomy and full bibliography. Twenty species are described, eleven of which and one genus (*Belgicella*) are new and mostly deep-water forms; they were obtained to latitude 71° 24′ S. There are no bipolar species but eight are found in Magellanic waters.

'Echinides et Ophiures.' R. Koehler (pp. 42, 8 pl., 1901).

There are eight echini and fourteen brittle stars. The Antarctic fauna is a special one, not closely related to Magellanic or Arctic faunas, and has no bipolar species.

'Brachiopodes.' L. Joubin (pp. 13, 2 pl., 1901).

Two new *Rhynchonellæ, R. racovitskæ* and *R. gerlachei,* and *Crania Lecointei* n. sp., were obtained south of latitude 70° S. The fauna, as in the case of the echini, seems distinct from any other, but most of the few specimens obtained were immature or imperfect.

'Copépodes.' W. Giesbrecht (pp. 49, 13 pl., 1902).

Some thirty species, of which about half were new, and one new genus, were obtained. Twenty per cent. of the species are common to the Arctic region, or bipolar. This memoir has involved much labor and is profuse in detail.

'Acariens libres.' E. Trouessart (pp. 19, 2 pl., 1903); three Antarctic species; 'Acariens parasites,' G. Neumann (pp. 6); ('Aragniés et faucheurs,' E. Simon (pp. 7).

These papers are devoted to Magellanic forms, no Antarctic species are cited.

'Myriapodes.' C. Attems (pp. 5, 1 pl., 1902). Three Magellanic species noted. Includes also 'Collemboles.' V. Willem.

Six species treated, of which three are Antarctic, five new genera are proposed. Two of the Antarctic genera have no known close relatives elsewhere, the other, *Isotoma,* is cosmopolite. The Antarctic species have the eyes of reduced size and number, and the author thinks this may be due to the dim light of this cloudy region, and the tendency to adopt for protection a subterranean situs.

'Seals.' G. E. H. Barrett-Hamilton (pp. 20, 1 pl., 1901).

The species of the region were already known to science though imperfectly. The collections of the expedition enable the author to add important osteological and other data on the rare Ross and Weddell seals.

'Cetacea.' E. G. Racovitza (pp. 142, 4 pl., 1902).

The outfit of the *Belgica* unfortunately comprised none of the equipment needed for taking large whales, though the region abounds with the humpback, finback and other species. The true right whale (*Balæna*) is not found in the Antarctic, though it has been erroneously reported there. The author made the most of his opportunities, however, and obtained interesting photographs of the whales in different positions in the water, and many notes, in the discussion of which he settles several doubtful questions and throws light on others. He has inspected the literature of the Antarctic for references to cetacea and has tabulated the results.

'Amphineures, Gastropodes et Lamellibranchs,' P. Pelseneer (pp. 85, 9 pl., 1903); 'Cephalopodes,' L. Joubin (pp. 4).

Professor Pelseneer enumerates a few Magellanic species separately, and divides the Antarctic species into littoral, of which there are three species; fundicolar, of which there are twenty-nine, and pelagic, of which there are five. A few of the species were already known, as abyssal shells, but twenty-seven of the fundicolar species are described as new, and one is given a new generic name. Only four of the species belong to genera not found in the north polar or subtemperate regions, though the species are distinct. Of the two abyssal species previously named, one reaches the Azores, and one Prince Edward Island, in the North Atlantic. There are two forms

which are essentially Magellanic, and all three of the littoral species are related to the Magellanic fauna. The examination of the anatomy of the various forms preserved afforded opportunity for morphological notes of interest, especially those bearing on the relations of *Modiolarca, Philobrya,* etc. The cephalopods were represented only by beaks of cuttlefish found in the stomachs of seals and penguins more or less demoralized by digestive fluids and incapable of identification.

These brief indications will show how much this series of memoirs is likely to add to our knowledge of the Antarctic regions, and how much science is indebted to the intrepidity of the explorers and observers on board the *Belgica.*

W. H. Dall.

## *SCIENTIFIC JOURNALS AND ARTICLES.*

With the March issue the *Bulletin of the Michigan Ornithological Club* (quarterly) enters upon its fifth volume. The issue opens with the account of 'The Discovery of the Breeding Area of Kirtland's Warbler,' by Norman A. Wood, which is practically a full life history of this race species with an account of its breeding habits. The article is illustrated by a frontispiece showing the male and female beside a nest; a photo of the egg and other views showing the nesting situation and nature of the country (Oscoda County, Mich.). Chas. C. Adams follows with an article on the 'Migration Route of Kirtland's Warbler,' which is illustrated by three maps. Under the head of Michigan Ornithologists is given a full-page plate of A. H. Griffith, director of the Detroit Museum of Art. Professor Walter B. Barrows, of the Michigan Agricultural College, announces 'A Forthcoming Bulletin on Michigan Birds' to be published by the agricultural college, and requests information from students in the state. Space is given to the Michigan Audubon Society which was organized February 27, 1904, as an auxiliary to the Michigan Ornithological Club, for the protection of birds in the state.

## *SOCIETIES AND ACADEMIES.*

### EXPERIMENTAL PSYCHOLOGY.

A meeting of experimental psychologists was held at Cornell University, April 4 and 5. The session of Monday morning was opened by Professor L. Witmer with a paper on the 'Laboratory Investigation of Backward Children.' This was followed by a discussion of various phases of the reaction experiment, in the course of which the following papers were read: Professor C. H. Judd, 'Analysis of Movements made in Simple and Complex Reactions'; Dr. G. M. Whipple, 'The Simple Reaction as a Test of Mental Ability'; Professor C. E. Seashore (read in absence), "The Psychological Term 'Observer.'" Professor Witmer also spoke on 'Shortest Reaction Values,' and upon the 'Difference between Sensory and Muscular Reactions.' At the afternoon session, Professor Judd read a paper on 'Eye Movements studied by Photography, with Special Reference to the Müller-Lyer, Poggendorff and Zöllner Figures'; Mr. H. C. Stevens outlined a 'Study of Attention by the Method of Expression'; and Dr. J. W. Baird spoke upon recent investigations in perimetry.

The session of Tuesday morning was opened by Professor E. C. Sanford, with a report of Dr. Kuhlmann's experiments upon idiots. Mr. C. E. Ferree emphasized the importance of adaptation in fluctuations of the visual attention, and Professor W. B. Pillsbury discussed the 'Influence of Closing Eyes upon Attention Waves.' At the afternoon session Professor Pillsbury read a paper on 'An Apparatus for Investigating Torsion during Eye Movement, with some Results'; Professor Judd spoke upon the 'Imitation of Tones, With and Without Distraction'; Professor Sanford demonstrated a novel form of color mixer, and Mr. G. H. Sabine a 'Speed Regulator for the von Frey Limen Gauge.' The remainder of the afternoon was devoted to a business meeting, and to an inspection of the psychological laboratory. At an evening session, held in the psycho-educational laboratory, Dr. Whipple spoke upon 'Some Difficulties in the Use of the *A*-Test,' and demonstrated an apparatus for determining the relative legibility of the small letters.

The following papers were read by title: Dr. J. W. Baird, 'Convergence and Accommodation in the Perception of Depth'; Miss M. Castro (paper introduced by Professor J. R.

Angell), 'An Outline of an Experiment Investigating the Interrelations of Taste and Smell'; Mr. C. E. Galloway, 'Fluctuations of Attention and Vasomotor Waves'; Professor E. B. Titchener, "The 'Psychophysical Series' as a Training Experiment: Methods, Results and Computation"; and 'Type *vs.* Instruction in Psychophysical Work.'

It was decided that a similar meeting should be held in 1905; and Professor Münsterberg's invitation to the psychological laboratory of Harvard University was gratefully accepted, with the understanding that the meeting should be transferred to Clark University in case of any interference with Professor Münsterberg's plans.

### PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 582d meeting was held March 12, 1904.

Dr. A. F. Zahm continued his paper begun at the previous meeting, discussing several specific problems in aerodynamics in the light of the constants he had determined experimentally; he pointed out that some of the forms of flying machines of noted experimenters had an excessive amount of skin friction, and showed some of the conditions of maximum efficiency in such machines.

Mr. G. K. Gilbert spoke on 'The Feasibility of Measuring Tides and Currents at Sea.' This problem appeals to the geologist as well as to the hydrographer. It was suggested that a hollow vessel might be anchored at some distance below the surface of the sea, containing a registering pressure gauge on which the superincumbent column of water acted. Various forms of gauges were discussed as to their range, sensibility and adaptability.

Charles K. Wead,
*Secretary.*

### THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy held on March 21, Professor W. L. Eikenberry delivered a lecture on the 'Principles of Ecology and the Development of Plant Societies.' He showed that the science of botany had been greatly advanced by the study of plant-ecology or plant-sociology, *i. e.*, by the study of plants in their external relations to each other, and the adjustment of plants and their organs to their physical surroundings. Formerly taxonomy, or the determining of a plant's position in a scheme of classification, was the aim of all students and teachers. Now the study of botany is pursued on a broader scale, plants being studied as living things, which are not scattered at haphazard over the globe, but are organized into definite communities, determined by the conditions under which certain plants can live. Ecology, since it considers plants and their environments, takes the student directly into the field, instead of confining him to herbarium specimens. Systematic botany, while very essential, should always be made one of the means, and not the final end of botanical study.

By a series of lantern slides Professor Eikenberry showed the transition from a pond society to a swamp-forest. First we have a lily-pond with sedges at the margin of the water. As the lily-pond loses its water, the sedges and swamp-grasses crowd in. This swamp-moor is followed by shrubs, and finally by a swamp-forest, such as tamarack, pine and hemlock. Professor Eikenberry also traced the developments of plant societies adapted to dry air and soil. Various plants, such as lichens, mosses and small crevice plants, are able to live upon bare rocks. As these exposed rocks are weathered away the crevices become larger, and seeds of small plants find lodgment there. As time goes on, the fissures increase in size, more soil is formed, and shrubs and finally trees root there, resulting ultimately in forests.

### CLEMSON COLLEGE SCIENCE CLUB.

At the regular monthly meeting held February 26, 1904, Dr. H. Metcalf presented a paper entitled 'A Contribution to Culture Methods.' The speaker gave a description and exhibition of special apparatus for cultural work in plant pathology, as published in the *Journal of Applied Microscopy* for September, 1903. This was preceded by a demonstration of various bacterial and fungus colonies through the projecting microscope. Professor P. T. Brodie gave a paper entitled 'Engineering Features of the Isthmian Canal.' The speaker discussed his subject under the

following topics: (1) Brief history of the Isthmian Canal problem, with special reference to the Nicaragua, Panama and San Blas routes; (2) comparative advantages of the canals at Nicaragua and Panama; (3) general description of plans for Panama Canal, as made by the government commission and now adopted by provisions of treaty with the Republic of Panama, and a comparison of this with the sea-level canal of de Lesseps and other plans by the French companies; (4) a discussion of the engineering difficulties involved at Culebra cut and the Bohio dam; (5) The Bohio Lake and the Gigaganti Spillway for the control of the summit level and the floods of the Chagris River; (6) a comparison of the advantages of a lock canal at Panama with those of a sea-level canal at Mandingo, involving a tunnel through the continental divide. The lecture was illustrated with forty lantern slides, prepared from drawings and photographs.

F. S. SHIVER,
*Secretary.*

CLEMSON COLLEGE, S. C.,
March, 1904.

## DISCUSSION AND CORRESPONDENCE.

### THE UNIVERSITY OF CINCINNATI AND ITS PRESIDENCY.

THE history of the University of Cincinnati for the last five years, has, without doubt, a most important bearing upon the principles of university government. This is due to the features of its early organization and to the peculiar relations which it sustains to the community. The original endowment of a 'free college for white children' by Charles McMicken in 1858, the incorporation of the University of Cincinnati by act of legislature in 1874, with McMicken College as an integral part of it; the issue of city bonds for construction and the levying of a tax for the partial support of the institution, were the acts that gave a free university to Cincinnati.

A municipal university, distinctly anomalous among American universities, had to be provided with a mechanism of government. This was arranged for by the statute which created a board of directors of nineteen members including the mayor of the city, *ex officio.* Originally twelve of these members were appointed by the superior court and six were selected by the board of education, but in 1892 the law was so amended that the superior court appointed the entire board, thus taking it out of politics. The board had and still has control of the funds and of the faculty of the academic department alone, which for a number of years was the only department of the institution actively organized and in working condition.

In the beginning the board of directors invested the dean of the faculty with executive functions, but in 1877 it elected Rev. Thomas Vickers rector. This arrangement lasted until 1884, when, after a long and sensational 'investigation' the executive office again became vacant. An interregnum ensued until 1885, when General Jacob D. Cox, then, and for some years before and after, dean of the Cincinnati Law School, became president. His incumbency lasted until 1888. These two experiences and the dearth of funds prompted the board of directors to revert to the old policy of having the dean of the academic faculty exercise the executive functions in that department, and to provide, furthermore, that members of the faculty in the order of seniority should serve as dean, each one to serve for a year.

In 1887 the board of directors, prompted by a desire to expand the institution to the proportions of a real university, affiliated certain local professional schools, namely, the Cincinnati Law School, the Medical College of Ohio, the Miami Medical College and the Ohio Dental College. Each of the affiliated institutions was only nominally a department of the university, since each maintained its autonomy, its own governing body and acted under its own charter.

In 1892 the relations with the two medical schools were terminated, but the Medical College of Ohio in 1896 by surrendering its charter to the university became the medical department; still, however, with many rights reserved, viz., the right to nominate all the members of its faculty, the control of its funds and of its internal management.

The new arrangement with the law school was a ten years' contract (also begun in 1896) which recognized the right of the trustees of the Cincinnati College to control all funds of the law school and reserved to the faculty the right to nominate all members of the teaching staff and the complete control of its affairs. Thus the law school remained the department of law of the university only in name, a distinction for which the university agreed to pay and yet pays annually out of public tax money the sum of a thousand dollars as 'rental' for premises owned and occupied by the law school itself. The original articles of affiliation with the dental school were not disturbed and the latter institution, a purely private and proprietary enterprise, secures valuable advertising through university publications.

This brief statement sufficiently indicates the influences that were operative, especially during the decade from 1890 to 1900.

The board of directors, made up of business and professional men, acted as safe conservators of the funds of the institution, new buildings were erected in Burnet Woods, the old buildings were given over to the medical school and the material interests of the institution were carefully supervised. At this point the efficiency of the administrative board ended. With no practical university man as a member it failed, for a long time at least, to grasp the real necessities of the academic department.

Each professor conducted his work according to his own ideas of what should be the quality and quantity of devotion to the interests of the institution, with the inevitable *reductio ad absurdum*. Each successor, with the allurements of the vacant presidency before him, sought to make a record that would secure his promotion thereto, while certain of his colleagues, awaiting their turns, were far from giving him a helping hand. 'Members of the board of directors,' so that body stated in a formal declaration, 'received with annoying frequency denunciatory statements from the professors about every member of the faculty.' 'As a matter of fact,' declared the governing body, 'if all the suggestions of removal urged by members of the faculty against members of the faculty had been acted upon, not a single member of the present teaching body would have been left in position.' With incessant conflict in the faculty and with the students not amenable to discipline, things had manifestly reached a crisis. The directors began to think—and one of the first thoughts that came to them was that in all the years that had passed they had been altogether too perfunctory in the choice of professors. Selections had rarely been properly safeguarded, and too many of them had been made through either the 'push' or the 'pull' of the applicant. A régime, absolutely untenable, had become established, the termination of which by radical changes in the personnel of the faculty became the imperative duty of the directory.

This step having been informally but none the less definitely resolved upon, the selection of a new faculty became imminent. The disastrous experience of the directors with the incumbent faculty caused them to recoil from the responsibility. There was a unanimous determination to call a president, a man of executive ability, familiar with the educational world, who, in the selection of new professors, might save the institution from other pits such as those into which it had fallen. Committees were sent to Princeton, Harvard, Yale, Columbia, University of Pennsylvania, Ann Arbor, Chicago and elsewhere. A committee, of which Hon. Wm. H. Taft, then dean of the law school, now secretary of war, was chairman, after investigating a number of candidates reported favorably on Dr. Howard Ayers, then professor of biology in the University of Missouri. Dr. Ayers, after visiting the institution and having been informed of the internal conditions, after having been told that the directors had resolved upon extensive changes in the faculty and after having been impressed that his special and important task would be to select a new faculty and that only the successful reorganization of the faculty and the affairs of the academic department would warrant his continuance, was duly elected. Recognizing an unusual opportunity to render a great service to the cause of sound education, he accepted the office un-

der these conditions and took up the work in July, 1899, in the executive position. He was fully assured that the successful accomplishment of this task would secure his administration and other grateful recognition at the hands of the board and from the community.

The work of President Ayers progressed without special incident until late in the ensuing winter. About this time, after having become familiar with the general situation, President Ayers, in consultation with members of the governing body, insisted that members of the faculty who (some of them before his coming) had been selected for dismissal ought, in fairness, to be notified quietly of the fact in time to secure employment elsewhere. However, before this thoughtful policy could be made effective, members of the faculty themselves on January 12, 1900, precipitated the issue by arbitrarily demanding of the president the names of all who were to be deposed. Certain professors in no wise involved, by inconsiderate action on this and immediately ensuing occasions, rendered their longer retention impossible.

It thus happened that the final number of changes made was slightly increased beyond what was at first intended. The statement was repeatedly made by the daily press that the entire faculty had been dismissed. The fact is that out of a university teaching corps of about 150 members only 8 were asked to resign.

The fact that this action had to be effected through the executive led to the erroneous supposition that the changes were made under the initiative of President Ayers. It was immediately inferred that he was a centralist in university government, an assumption that prompted representatives of the medical faculty, jealous of their prerogative to nominate their own fellows and of their complete control of the medical department, to array themselves in opposition to him.

The matter was taken up by a few citizens who, instigated by deposed professors, called a small meeting and adopted resolutions of sympathy. This was followed by representations to the board of directors that the deposed professors be given a trial. This demand the board of directors, after reviewing the whole case, including the representations that members of the faculty had made about each other, replied: "If the statements made by professors against professors were true the verdict should be upon that basis; if the statements were untrue the moral perturbation thereby implied makes their authors unfit to be identified with an institution of learning; in either event the faculty falls as a self-condemned body."

This incident marked the close of all formal demonstrations. The professors, with two exceptions, completed their year's labor, their work being taken up the following autumn by men who had been selected by President Ayres and who were confirmed by unanimous vote of the board of directors. The internal administration for the first time in many years became tranquil, the enrollment increased and the student body became enthusiastic supporters of the new régime.

A morning paper, however, for personal reasons, had become inimical and kept up a fusilade of abuse, texts for its various articles being furnished by practically the only opposition that President Ayers encountered in his governing board, that of a single member, a representative of the medical faculty, whose coincident service as a professor and a trustee must be recognized as a violation of all correct principles of university government.

This newspaper antagonism was kept up for nearly two years and culminated only when President Ayers by formal vote of the board of trustees had been vindicated of charges, petty in character, that had been preferred against him by his opponent on the board.

The battle so long and bitterly waged against President Ayers had apparently been abandoned. The community at large recognizing that an efficient and harmonious faculty had been installed, that the attendance had increased, that the standard of scholarship had been advanced, that the student body was earnestly and loyally cooperating with the teaching corps, which latter body was enthusiastically engaged in promoting the welfare of the institution, and knowing that benefactors were manifesting renewed interest in the insti-

tution, accepted the condition as a praiseworthy achievement.

The following excerpts from the other city papers indicate that no countenance was given by the press to the attacks of the one morning sheet.

A weekly paper had the following to say, under date of January 13, 1900, about the reorganization of the university:

Every thorough Cincinnatian ought to feel satisfied that our big university has at last got a head in Dr. Howard Ayers. If an institution ever needed a complete house cleaning the University of Cincinnati did.

For years it has been a burlesque purely through being without a disciplinarian at the head. Dr. Ayers has taken the proper steps to place it upon its feet rightly, and the trustees have shown common sense in supporting him. * * * A continuation of the old methods in vogue at the university can result in but one way—the death of the institution.

January 20, 1900, a local medical journal made the following editorial statement with reference to the relation of the medical and law departments to the university:

They are and are not a part of the university, and from their first conjunction have occupied anomalous positions, which in the very nature of things can not be harmonious or lasting in their nature. They are a paradox. In neither the medical nor law faculties does the president or board of directors have any voice in their management. They stand at this time as disembodied spirits, and, being disjoined, there can be little or no harmonized unification of interests, which in the general cause of education in Cincinnati is exceedingly unfortunate.

April 14, 1900, a daily evening paper made the following comments on the appointment of Dr. Ayers to the presidency of the University of Cincinnati:

The public knows little of the troubles that beset the modern college president's path and the peculiar conditions under which most of them have to work. These conditions were suddenly made clear in Cincinnati by the appointment, after years of executive chaos, of a president to the university.

In the current *Atlantic Monthly* appears an article on the perplexities of a college president which might have been written with the late University of Cincinnati discussion as a text, so thoroughly does it meet the points that were raised:

The new president, continues the writer, finds that he is simply left to make the best of the present situation; to do what he may and can with such men as are already in place; to make his peace with malcontents, to be patient under opposition, to do the work of three men because the other two at least are not ready to cooperate with him, to explain misunderstandings, quietly to contradict misstatements when he is so fortunate as to have the opportunity to do this, to supplement the inefficiency of others, and to furnish enthusiasm enough not only to carry himself over all obstacles and through all difficulties, but to warm blood in the veins of others whose temperature never rose above 32 degrees Fahrenheit. To compel him to undertake this work in this way is not only cruel to him personally, but it is as unnecessary as it is unwise.

The writer in the *Atlantic* points to the fact that the educational executive is invariably handicapped by the precedent which, though it grows weaker, is still all-powerful, the feeling that the college professor is to be set upon a pinnacle above criticism and beyond the reach of complaint. "It takes an act of the trustees to put a man in such a position but it takes the act of God to put him out."

Buildings that, for the most part, had been added during President Ayers's three years of service were publicly dedicated at commencement time in 1903 by ceremonies the most successful in the history of the institution, Hon. James Wilson, secretary of agriculture, and Hon. Francis B. Loomis, first assistant secretary of state, being among the orators.

In the meantime, however, another and altogether different set of influences were at work. In the early part of 1902 the Supreme Court of Ohio, in the case of State *vs.* Jones, rendered a decision which practically destroyed all the then existing legislation relating to the government of municipalities in the state by declaring it to be special legislation and, therefore, unconstitutional. The situation was so critical that Governor Nash called an extra session of the legislature, which, on the twenty-second day of October, 1902, passed the law known as the 'Municipal Code of Ohio.'

This law gave to all municipal corporations the right to appropriate property for university purposes, excluded the tax for university purposes from the maximum levy for general purposes, provided for *pro rata* taxation for university property, for public improvements on university grounds; made the city auditor the supreme accountant of the university funds and finally provided that the control of such universities shall be vested in and exercised by a board consisting of nine electors of said municipal corporation who shall be appointed by the mayor. The board thus constituted was empowered to exercise full control over the university.

The provisions of this law, relating to the appointments of trustees, when brought forward in the legislature, were met by appropriate protest, but the principle of uniformity which it was intended to establish in the government of municipalities, a principle by which authority and responsibility alike were centered in the mayor, prevailed—and the University of Cincinnati went into politics.

Of the board appointed, eight members are republicans, and one is reputed to be a democrat.

Scarcely had the eloquence of Secretary Wilson and Secretary Loomis and the applause over the achievements of President Ayers died into an echo, when a concerted move was made to displace the executive under whose intrepid leadership so much progress had been made.

It was then discovered that some of the alumnal members of the board, former pupils of the deposed professors, whom, in one or two instances, they had formerly served in a professional capacity, had entered into a compact with a minister and a doctor—a representative of and a professor in the medical faculty, also members of the new board, to remove President Ayers. About this time one member announced in the public press that he knew how every member of the board stood upon the question of dismissing President Ayers before they were appointed.

It was openly stated that this compact was a written one and that it was entered into not later than a few days after the appointments were made. An inspired article in one of the city papers declared that President Ayers was about to resign, as a majority of the board was unfavorable to his administration.

Word was sent in a personal way to President Ayers intimating that a change in the administration was desired. President Ayers, however, chose to stand upon the record of his achievements and to place the onus of his displacement, if he had to be displaced, upon the board where it belonged.

When the matter became public there were general and surprised inquiries as to the cause. The answers made vague references to 'arbitrariness' and 'lack of tact,' but more generally consisted in the statement that 'Ayers is not the man for the place.' Dr. Charles A. L. Reed, former president of the American Medical Association, and a member of the former board, answered these objections as follows: "There is, it is true, some talk about a 'lack of tact'—but the tact of President Ayers seems to have given the university the best four years since its foundation by Charles McMicken; there are mutterings about 'arbitrariness'—but the arbitrariness of President Ayers seems to be of the sort that has brought order out of chaos and established government instead of anarchy; and there are whisperings about 'tone'—but the tone of President Ayers seems to be of the stuff that, imparted to professors and students alike, has resulted in hard work in the classroom and fair play on the athletic field and that has infused high ideals into the lives of all who have been brought under his influence."

Mr. E. C. Goshorn, a leading manufacturer and business man, wrote: 'To-day the university occupies a position of which we may all well be proud, and it certainly would be a mistake to ask for the resignation of the man to whom this result is due in part if not wholly.'

Hon. John W. Warrington, a leader of the Cincinnati bar, wrote: "I had supposed that the last commencement day of the university furnished satisfactory evidence to all, not only that good work was being done at the univer-

sity, but that there was harmony among all concerned. I regard the present outbreak as highly injurious to the future of the institution.'

Judge Wm. Worthington, one of the most highly esteemed of citizens and a patron of the institution, wrote concerning President Ayres that: "It is undoubtedly true that the university has prospered highly under his management, and that the teaching force has been strengthened, the morale of the faculty improved and the zeal and interest of the students stimulated since he took charge. What has been done is the more remarkable in view of the animosity aroused by the acts he was called upon to perform when he first took charge, and the constant criticisms, engendered in part by those animosities, to which he has been since subjected. His entire and sincere devotion to the interests of the university can not be denied and have borne good fruit which all may see."

Hon. Wm. H. Taft, then Governor-General of the Philippines, wrote from Manila, saying: "Why, after Dr. Ayers has accomplished that which he was employed to accomplish, and has brought about such an excellent condition of affairs, it should now be thought proper to dismiss him, I can not for the life of me see. * * * It would seem to be a time when those who have the interests of the university at heart should sink their personal likes and dislikes and recognize that the man under whom the university has made such distinct progress should continue at the head of it."

The matter was, therefore, postponed from the summer meetings until November, when, notwithstanding the foregoing and numerous other protests from alumni, students and citizens, all of which went unanswered, a resolution was passed declaring the presidency vacant after June 30, 1904, President Ayers being retained until that time. A few days later President C. W. Dabney of the University of Tennessee was elected to the vacancy.

The following are some of the salient points in the situation:

1. The lack of security of tenure of the executive officer of the University of Cincinnati, owing to the inability of the board of directors to make contract, good for more than one year, or in any other way to secure him against sudden and unwarranted dismissal. It is true a five-year contract signed by the officers of the board of directors has been made with President Dabney, but this document has no value beyond the expression of a moral obligation in written form. When President Ayers came to the University of Cincinnati in 1889 he also asked the board for a written contract, and upon being informed of their inability to make a contract for the payment of money not in the city treasury and upon the strongest assurances given him by the board of directors and by other prominent citizens, he concluded that he would be safe in accepting the offer of the presidency without exacting a binding legal document, which, it was discovered, the board was not in position to execute.

2. The instability of the governing board, which is subject to the fluctuations of municipal politics.

3. That the administrative officer who came to the university under very adverse conditions, and performed a task seldom asked of an executive officer, and who, overcoming very unusual difficulties, carried out a successful and satisfactory reorganization of the university, was dismissed without recognition and with a refusal to consider the existing obligations towards him.

4. The effect upon the educational work of the university since the political powers have assumed the direction of its affairs, thereby carrying it into the maelstrom of municipal politics, is such as to render uncertain and unsatisfactory all attempts to carry out any desirable educational program.

5. The unceasing efforts of religious denominations to control the teaching of the university and to establish in it religious conditions which are not permissible in an institution supported by taxation, but which may now be made effective through political agencies.

The careful student of the establishment, government and development of universities will surely find instruction in the foregoing

facts. There are any number of interesting questions involved in the situation. The right of municipalities to support institutions, especially professional and technical schools, in whole or in part by taxation; the practicability of combining endowments with public revenues in the maintenance of universities; the policy of appointing a governing board by political agencies as contrasted with a self-perpetuating board; the question of large administrative boards as contrasted with small ones; the principle of alumnal representation in governing bodies; the right of constituent faculties to representation in the directory, and the results thereof; the right of faculties to nominate their own associates, and the results thereof; the tenure of professional appointments and the obligations, moral and legal, of universities to their executives; are a few themes suggested by recent events in the University of Cincinnati. X.

### NATURAL AND UNNATURAL HISTORY.

To the Editor of Science: Every student of comparative psychology who has at heart the cause of sound education must welcome such criticisms of the writings of Mr. William J. Long as have appeared in recent numbers of Science.* Not because Mr. Long deserves, on his merits, either criticism as a naturalist or condemnation as a teacher, but solely because of the far-reaching influence for evil which must inevitably attend the wide circulation of his books, and their possible offspring, through the schools. The present writer has not asked for space in your journal in which to review the numerous publications of this facile fabricator of fiction, nor yet to discuss the indisputable facts of animal behavior and intelligence which have suffered such distortion at the hands of Mr. Long—to name only the chief of a whole tribe of popular writers who, by the prostitution of their talents, have brought upon themselves the just censure not only of naturalists, but of all right-minded educators.

Since the sad case of the Rev. William J. Long has already been brought forward in your journal, it would seem only fitting that it should be still further presented in all its preposterousness. Let it be understood from the outset that no personal feeling of any sort whatever prompts or accompanies this letter, which is intended solely to place on record a few reflections suggested by the recent controversy in the popular press and the aforesaid communications to Science, with a view to enlisting still further, perhaps, the interest of scientific men on behalf of a real educational need, and, indirectly, of warning educators against the adoption of a point of view and a method which threaten to make of 'nature-study' not merely a farce, but an abomination to science and a menace to educational progress. Although the writer can have no personal quarrel with Mr. Long, with whose very name he was unfamiliar until Mr. Burroughs—perhaps unwisely?—brought it into unmerited prominence, the duty does not on this account devolve upon him of examining here the statements of *all* our popular interpreters of nature. Mr. Long, to whom public attention is temporarily directed by reason of certain rather ludicrous circumstances, is taken merely as a type of his species. (Doubtless there are naturalists who would limit this particular species to the type specimen!) Mr. Thompson-Seton has also disseminated vicious notions of animal mentality, but, apart from his inexcusable prefatory insistence upon the essential truthfulness of his narratives, and certain matters of taste which scarcely fall within the scope either of this letter or of your journal, his case may be dismissed as relatively unimportant. Besides, it is whispered that he has *reformed.* If Mr. Long is but one among many offenders, he is *facile princeps,* and Mr. Thompson-Seton should not be named in the same breath. Moreover, one may doubt Mr. Long's capacity for reform. As a romancer he does not stand alone, but as a 'hopeless romancer' he occupies a unique position. This is because of his inordinate gullibility. If it turn out that

* 'Woodcock Surgery,' by William Morton Wheeler, Science, N. S., Vol. XIX., No. 478, pp. 347–350, February 26, 1904; 'The Case of William J. Long,' by Frank M. Chapman, Science, N. S., Vol. XIX., No. 479, pp. 387–389, March 4, 1904.

Mr. Thompson-Seton has really reformed, we shall no longer be permitted to accuse him of gullibility. Meanwhile alternative hypotheses need not concern us here.

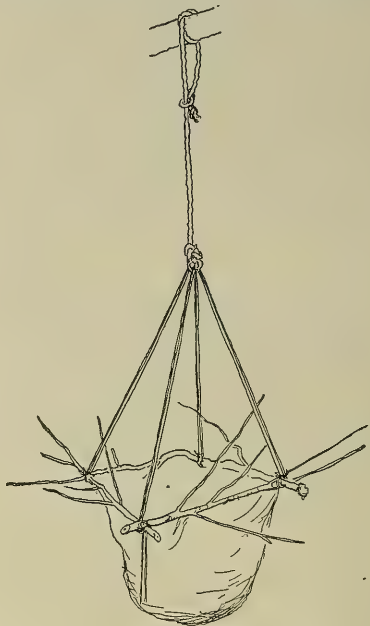
That Mr. Long is a 'hopeless romancer' has already been abundantly proved by Mr. Burroughs's article in the *Atlantic Monthly* for March, 1903,* which, although obviously unfair in spots, must be regarded as essentially sound, and in some respects even 'too temperate,' as Mr. Wheeler has said. If anything remained to be added to Mr. Burroughs's effective criticism of Mr. Long's 'sham natural history,' the deficiency has been bountifully supplied by Mr. Wheeler and Mr. Chapman, both eminent as scientific naturalists.†

It would also seem a work of supererogation to attempt further to establish Mr. Long's gullibility, especially after Mr. Chapman's excellent letter, with its telling quotations. Indeed, I have no intention of arguing the matter further, but I happen to have in my possession a carefully prepared outline sketch, executed by Mr. Clifton Johnson, the well-known illustrator, of a mare's nest which Mr. Long has seen fit to describe as the work of orioles, and (by the owner's permission) I beg leave to reproduce it in your journal, that your readers may judge for themselves of Mr. Long's competency to instruct the youth of our land in the 'Secrets of the Woods.' I quote for comparison Mr. Long's own account of this nest and the manner of its fabrication, from his article on 'The Modern School of Nature-Study and its Critics' in the *North American Review* for May, 1903 (pp. 688–698):

* 'Real and Sham Natural History,' *Op. cit.*, pp. 298–309.

† One could have wished that Mr. Wheeler had not felt obliged to indulge in that rhetoric about osteogenesis, etc., presumably intended to take off Mr. Long's manner, but incidentally serving to prejudice certain readers against an otherwise convincing criticism. Surely Mr. Wheeler does not believe that the average country doctor, who sets all the broken bones of his township is 'deeply versed in osteogenesis'! Nor would he deny him, on this account, his proper share of intelligence.—*Non potest non peccari.*

Last spring, two orioles built in a buttonwood tree, after having been driven away from their favorite elm by carpenters. They wanted a swinging nest, but the buttonwood's branches were too stiff and straight; so they fastened three sticks together on the ground in the form of a perfectly measured triangle. At each angle they fastened one end of a cord, and carried the other end over and made it fast to the middle of the opposite side. Then they gathered up the loops and fast-



ened them by the middle, all together, to a stout bit of marline; and their staging was all ready. They carried up this staging and swung it two feet below the middle of a thick limb, so that some leaves above sheltered them from sun and rain; and upon this swinging stage they built their nest. The marline was tied once around the limb, and, to make it perfectly sure, the end was brought down and fastened to the supporting cord with a reversed double-hitch, the kind that a man uses in cinching his saddle. Moreover, the birds tied a single knot at the extreme end lest the marline should ravel in the wind. The

nest hangs above my table now, the reward of a twenty-five years' search; but not one in ten of those who see it and wonder can believe that it is the work of birds, until in the mouths of two or three witnesses who saw the matter every word has been established (p. 692).

Let the description be compared with the sketch; let it be observed that Mr. Long does not affirm that he himself 'saw the matter' (*i. e.*, the fabrication of the nest by the birds?); let it be remembered, however, that Mr. Long accepts this remarkable structure as the work of orioles—there are the usual 'two or three witnesses' (one can not help wondering if they are the same 'friends' who have played so many practical jokes on Mr. Long), and, above all, from Mr. Long's point of view, *there is the nest itself, which hangs above his table now,* unless some ill fate has befallen it since last May, when the article appeared. This episode of the nest reveals a general incapacity for the estimation of evidence which must vitiate everything else that Mr. Long reports. *Falsus in uno, falsus in omnibus.*

The article in question is such a remarkable production throughout that, perhaps, we should not take leave of it without quoting a few characteristic passages, which may serve to set forth Mr. Long's curious creed.

"The study of Nature," we are told, "is a vastly different thing from the study of Science; they are no more alike than Psychology and History. *Above and beyond the world of facts and law, with which alone Science concerns itself, is an immense and almost unknown world of suggestion and freedom and inspiration, in which the individual, whether animal or man, must struggle against fact and law to develop or keep his own individuality.* It is a world of 'appreciation,' to express it in terms of the philosophy of Professor Royce, rather than a world of 'description.'* It is a world that must be interpreted rather than catalogued, for you can not catalogue or classify the individuality for which all things are struggling. * * * This upper world of appreciation and suggestion, of individuality interpreted by individuality, is the world of Nature, the Nature of the poets and prophets and thinkers. Though less exact, it is not less but rather more true and real than Science, *as emotions are more real than facts* [*sic*], *and love is more true than Economics*—* * * 'I study facts and law; they are enough,' says the scientist. 'We know the tyranny of facts and law too well,' answer the nature-students. 'Give us now the liberty and truth of the spirit.' * * * In a word, the difference between Nature and Science [*sic*] is the difference between a man who loves animals, and so understands them, and the man who studies Zoology" (pp. 688–689.—Italics mine here and throughout).

*Mr. Long evidently believes in hitching his chariot to a star!

Scarcely could the 'miraculous' vocalizations common among the earlier Christians have been more unintelligible than this. Such crude misapprehension of contemporary philosophic discussions, such hopeless confusion of categories, such aimless emission of words—mere words,—such pitiful cries of an individual struggling against every fact and law, both of thought and of language, 'to develop or keep his own individuality' (which?), it would not be easy to match outside the literature of Christian Science. Specific comments upon our subject's phraseology would spoil the flavor of the original.*

Men of science should perhaps pause to reflect, in the presence of such crass misrepresentations of the nature and scope of science, whether they may not be responsible, in some measure, for the state of affairs which has made it possible for a confessed intellectual anarchist like Mr. Long to obtain a hearing in the schools. If 'nature-study' is what it is above represented to be, let us return without delay to the respectable, if meager, modicum of knowledge comprehended under the one-time useful trinity of R's; but if 'nature-study' has for its object the observation of fact and the recognition of law, without sacrifice of inspiration—if it

*What a fine case of mixed categories for Professor Münsterberg!—but Professor Münsterberg apparently thinks it unnecessary to dredge in such deep waters of sciolism for his specimens.

be capable of nourishing the normal growing mind—then let us see to it that it be pursued and taught according to the full measure of its possibilities as a legitimate source of inspiration.*

By just such a curious inconsequence as might have been expected from one given to 'speaking with tongues' as above, Mr. Long insists that he has been careful never to record an observation until he has 'verified' it from the testimony of another. The 'confirmation' of most of his stories has come from the guides and trappers of his acquaintance. But in a 'world of suggestion and freedom and inspiration' why bother about verification? Why trouble the trappers? Perhaps the trappers appreciate Mr. Long's 'struggle against fact,' and cheerfully lend their aid in behalf of the development and maintenance of his individuality!

But Mr. Long is not a consistent dreamer of dreams and confirmer of the same through the cross-questioning of trappers; he thinks it important to remind his readers that 'for over twenty years' he has 'gone every season deep into the woods.'* And his publishers, Messrs. Ginn and Company, have issued a little pamphlet,† by way of apologizing for their literary *protégé* and incidentally advertising his books (to all of which Mr. Long submits as if it were quite a dignified thing to be thus personally defended and advertised), in which the public is favored with reproductions *from photographs* of Mr. Long in his boat, of his camp in the woods, and the like. *Mr. Long has been on the ground!* But so have his 'wood folk.' *Mr. Long has been a field observer from his youth!* As much may be said of the wild ass.

Possibly even Mr. Long recognizes that mere camping out among the 'wood folk' is

* No objection is here implied to the frankly imaginative treatment of nature. The same 'fact' may be differently apperceived and transformed by the same mind for different purposes. There is an *artistic* observation as well as a *scientific* observation; accuracy being fundamental to both. Nobody can object, on *scientific* grounds, either to Shelley's relatively objective poems of nature, or even to Wordsworth's humanizing muse. Æsop's 'Fables' and Kipling's 'Jungle Books' are likewise secure from scientific attack. (This of course apart from a possible 'science of criticism.')

There is undeniably a place for *sympathy* in our relations with dumb animals, as in our relations with children; although between the mind of the most 'sagacious' mammal below man and the mind of the child which has outgrown the 'mewling and puking' age, there is probably an interval of considerable psychological significance. Josephine Dodge Daskam's clever stories about children, although not technically psychological, are nevertheless not contrary to fact. Her diminutive heroes and heroines are not made to appear interesting by being fantastically represented as stronger and wiser than their parents, or (like Mr. Long's animals) as differing radically in different localities—the youngsters of Massachusetts, for example, being revolutionary innovators in science and art and conscious critics of government, whereas children elsewhere stupidly make mud pies and dress dolls and harmlessly 'play police.'

But artistic creation apart, the 'natural history' point of view as distinguished from the formulation of quantitative or genetic 'laws,' represents at once a stage in the development of all natural science and a permanent aspect of its pursuit, as exemplified and expressed by nobody so sincerely and so happily withal as by the acknowledged masters of investigation themselves. Furthermore, the perception of 'law' has repeatedly given classic expression to what a scientific student of philosophy, the late Henry Sidgwick, first called 'cosmic emotion.' I am not even prepared to deny the legitimacy of metaphysical construction (possibly a species of quasi-poetry?) upon the basis of an assumed psychic homogeneity of the universe, such as we find reflected in polite literature, as, *e. g.*, in Robert Louis Stevenson's impressive *Pulvis et Umbra* (reprinted in the volume entitled 'Across the Plains,' Scribners, 1900).

* *Op. cit.*, p. 691.

† 'William J. Long and His Books: A Pamphlet Consisting Chiefly of Typical Letters and Reviews in Reply to Mr. Burroughs's Unwarranted Attack on Mr. Long.'—The unfortunate form of this authorized 'defence' of Mr. Long places one under an unpleasant obligation to refer more or less specifically to his personal qualifications,—an obligation from which one could wish to be released.

not in itself a sufficient qualification for the naturalist. Certainly Mr. Long's publishers know better, for they have taken pains, in the published apology already cited, to establish the competency of their author as a naturalist by an enumeration of the successive stages of his education. Quoting from *The Connecticut Magazine*,* they assert that 'his life has been one long search for the verities.' Unfortunately all searches are not rewarded, and length of search is after all of less moment than quality, which depends upon the searcher. Of the last we are told that "at eighteen years he made the sacrifice that few can measure, of giving up home, friends, money, position, to follow what seemed to him the truth," which, being interpreted, turns out to mean that he attended the Bridgewater Normal School, Harvard University, Andover Theological Seminary, Heidelberg University, where he took the degree of Ph.D., and the Universities of Paris and Rome! Are we to interpret this account of his martyrdom as an expression of educational cynicism?† But such self sacrifice is not in itself enough to make a good naturalist. 'He speaks four or five languages.' 'Four *or* five'—but if it should turn out that he speaks only four, and that five are requisite, what then becomes of the argument? No information is given relative to the candidate's preferences in neckwear, not to mention other equally relevant items. 'His specialties,' however, 'are philosophy and history,' and 'the study of nature and animal life is to him purely a recreation in a life of constant hard work,' yet 'it must be admitted that he brings to this study a rare training.' Granted! For it has not even been hinted that Mr. Long has ever studied any branch of natural science. But if philosophy is a specialty with him, perhaps biology is another: for he understands the one about as well—or as ill—as the other. (Witness the confusion of categories exhibited above.)

Let us see if Mr. Long's *methods* are as 'rare' as his training? The pamphlet is again at our service, with its fusillade of quotations from *The Ypsilantian, Our Animal Friends, The Christian Register, The Christian Advocate,* and all the rest! *The Ypsilantian** did not think it 'exactly nice' of Mr. Burroughs to write his *Atlantic Monthly* article; yet, at the risk of offending the good taste of *The Ypsilantian,* let us proceed in the interest of truth. Mr. Richard Burton has assured the readers of *The Boston Transcript*† that Mr. Long 'is a true naturalist, a scientist in quest of knowledge.' (This in spite of Mr. Long's assertion that nature and science differ as emotions differ from facts, and love differs from economics! *Hocus pocus, hocus pocus, X, Y, Z!*) The readers of *The Boston Herald*‡ know better; they know that "Dr. Long * * * never seeks exact facts, never studies consciously." Are we to infer that he dreams his stories? No, rather are we to believe Mr. Long's own account of his attitude toward nature, when he says (if correctly quoted by *The Boston Herald*— we have

* Vol. VIII., No. 1, Series of 1903, Pamphlet, pp. 2, 4.

† It is said that Mr. Burroughs has gone out of his way to emphasize the fact that Mr. Long is a clergyman. If this is true it would seem ungracious. Clergymen are, as a class, probably neither better nor worse than other respectable citizens. While a theological education is fraught with grave intellectual dangers, it certainly need not unfit a man for science, any more than a 'fulfillment of the requirements for the degree of Ph.D.' in a German university need fit a man for the same. There have been excellent naturalists who were clergymen to begin with. Mr. Burroughs's favorite, the good Gilbert White, is a case in point. Others, like the lamented Dr. Buckland, dean of Westminster, have attained eminence in natural science. Bitterness toward the clergy to-day strikes one as an anachronism. The ecclesiastic as we know him is either friendly towards science or indifferent to it, or, in any case, ineffectual against it. Time was of course when things were different; possibly Mr. Burroughs *remembers!* There remain, however, abuses enough to counteract without turning our wrath backwards. The dinosaurs have historical interest for us, although certain of our Mesozoic ancestors may have found it necessary to be veritable 'pragmatists' in their presence.

* July 16, 1903, Pamphlet, pp. 7–8.

† Date not given, Pamphlet, pp. 12–16.

‡ August 9, 1903, Pamphlet, pp. 18–19.

not the 'confirmation' of *The Ypsilantian* on this point): "I just love her, give myself wholly to her influence, expect nothing"—to which one is tempted to add, in the words of a current beatitude, 'Blessed are they that expect nothing, for they shall not be disappointed.' *The Boston Herald* is incidentally careful to explain how Mr. Long became a 'maker of many books.' "Before he was twenty he had filled a dozen note-books with curious, hitherto unrecorded habits of animals." A little later on "he prepared five articles, largely in fun, which, to his surprise, found ready acceptance and yielded a check of astounding proportions. Requests for book material followed, which he has since supplied at the rate of one or two books a year."

*Our Animal Friends** thinks Mr. Long's writings free of 'mawkish sentimentalism,' apparently because he does not insist that the hippopotamus is a 'beauty,' or the skunk a 'desirable companion.' And on July 9, 1903, *Public Opinion*† took the 'opportunity of reaffirming [its] belief in the correctness of Mr. Long's theories and of again advising the study of this author's work.' Just so, Mr. Hamilton Wright Mabie is quoted‡ as remarking that "Mr. Long has a fresh, sincere style, an eager curiosity, *and a trained habit of observation.*" Really, this is worthless from Mr. Mabie; yet just what one would have expected from this 'genial' preacher to the 'Christian Endeavorers of literature,' whose 'tolerance of temper' and 'mellifluous commonplaces' have apparently become too much even for the urbane, yet always discriminating, editor of the *Atlantic Monthly*.§ Nobody takes Mr. Mabie seriously as a critic of values any more. Nor should any man of letters, *as such*, presume to pass judgment on the competency of a naturalist for his task. If Mr. Long adds arrogance to ignorance, Mr. Mabie genially follows in his steps. A wise and far-seeing friend, and a man both able and eminent in science, is wont to predict that the science of the future will have to reckon painfully with a 'humanistic' opposition as dangerous as was the theological opposition of the past and far more insidious. Already there are signs of such an opposition, although as yet it acts chiefly as a stumbling block in the path of popular education; yet, to change the figure, it sometimes stands arrayed in the garb of education itself. *The New England Journal of Education** informs us that, "from Thoreau to Burroughs there has been no man quite so *lovable to wild animals* and to men at the same time as William J. Long. His experiences are well-nigh as fascinating in their way as were the songs of Jenny Lind." Speaking of Mr. Burroughs's criticism, it continues: "No one who has not made a saint of Burroughs and *has not been in love* with William J. Long, can appreciate the nightmare effect of that *Atlantic* article." But let us turn from this erotic effusion, and conclude our notice of Messrs. Ginn and Company's pamphlet by quoting Professor William Lyon Phelps, of the Department of English Literature in Yale University, who is reported as declaring that *"from the point of view of natural history,* as well as that of literary art, these books [by Mr. Long] are masterpieces."† Thus does the humanistic 'mush of concession' ever tend to 'debase the moral currency'; for it levels down as surely as it levels up, until all distinctions are obliterated, and truth remains just where Protagoras would have left it.

I need not discuss Mr. Long's modest-like defense of himself,‡ which would be ludicrous if it were not so pitiful—apart from certain just strictures upon minor faults of Mr. Burroughs's criticism. Which reminds one that Mr. Burroughs does not live in a house without some glass panes. But Mr. Burroughs knows that he has made mistakes, and knows how to account for them too. In the very *Atlantic* article which *The Ypsilantian* did not think was 'exactly nice,' Mr. Burroughs ac-

* August, 1901, Pamphlet, pp. 21–22.

† Pamphlet, p. 24.

‡ Reference not given, Pamphlet, pp. 16–17.

§ 'Mr. Mabie's Latest Book,' by B. P., *Op. cit.*, March, 1903, pp. 418–419.

* June 18, 1903, Pamphlet, pp. 8–11.

† Place not given, Pamphlet, p. 17.

‡ A letter from Mr. Long to the editor of *The Connecticut Magazine*, quoted in Pamphlet, pp. 25–32.

knowledges "the danger that is always lurking near the essay naturalist,—lurking near me as well as Mr. Sharp,—the danger of making too much of what we see and describe,—of putting in too much sentiment, too much literature,—in short, of valuing these things more for the literary effects we can get out of them than for themselves."* This is admirable, and reassures one in venturing upon an illustration of the way in which Mr. Burroughs has himself inadvertently yielded to this besetting temptation of the 'essay naturalist.' For I should be sorry to appear other than an admirer of Mr. Burroughs's writings; and even as a technical student of comparative psychology I agree in the main with his point of view, which I hope to discuss elsewhere, pointing out, for a wider public, what I regard, in the light of recent research, to be the limitations as well as the advantages of his somewhat arbitrary position on the rôle of instinct in animal life. Mr. Long's plea for animal individuality will then receive its full share of attention.†

* *Op. cit.*, p. 299.

† Mr. Long's contention that every boy who has watched animals has something to tell the 'naturalist' is not to be dismissed with a sneer. Some boys certainly have seen many things that no 'naturalist' has recorded. Nobody who has kept live animals feels that the stereotyped account of their behavior is quite adequate to the individual differences and the plastic 'accommodations' which they display; but these very individual differences and 'accommodations,' in so far as they have any importance, are themselves susceptible of *scientific* study. That they have not been sufficiently recognized in certain 'scientific' quarters can not be denied. But, if they have any meaning, they are 'facts' for the 'naturalist,' and as such have in the first place to be established on trustworthy evidence and then interpreted in accordance with 'law.'

The exceptional, even when true, can scarcely be said to furnish the basis for the most wholesome instruction in 'nature-study.' Nor is it of prime importance for science itself. *Cf.* E. L. Thorndike's remarks in his 'Animal Intelligence,' *Psychological Review*, Monograph Supplement No. 8, June, 1898, pp. 3–5. The widespread eagerness in the quest of the unusual and the gusto with which the anomalous is too often greeted when it is found are symptomatic of an intellectual malady which threatens the very life of reason in the community.

This communication is not concerned with questions of interpretation. When it comes to these, the comparative psychologist finds himself in an embarrassing position. His work, if not actually scouted, is often lightly regarded by the neurologist and the pure physiologist, on the one hand, in the supposed interest of a mechanical explanation of nature, while, on the other hand, it is ignored by the ordinary naturalist, untrained in the analytic method of psychology, and poohpoohed by the 'educated public,' complacent in its anthropomorphic sentimentalism. The serious student of animal psychology labors under the disadvantage of having a popular subject to investigate! Wherefore he has constantly to be on his guard and may often seem to be 'carrying a chip on his shoulder' through no fault of his own. If he be not a pessimist, however, he must regard popular interest in his subject as in the long run a boon upon which he may favorably reckon.*

But I have wandered far from my promise to illustrate Mr. Burroughs's tendency to 'slip up' unawares. It is in one of Mr. Burroughs's less satisfactory articles, on 'The Ways of Nature,'† that we read the following description of the peculiar behavior of the common 'sissing or blowing adder' (*Heterodon platyrhinus*), when teased or persistently attacked:

> It seems to be seized with an epileptic or cataleptic fit. It throws itself upon its back, coiled nearly in the form of a figure 8, and begins a series of writhings and twistings and convulsive movements that is astonishing to behold. Its mouth is open and presently full of leaf mould, *its eyes are closed*, its head is thrown back, its white belly up; now it is under the leaves, now

* The camp of human psychologists is not a scientific Utopia, but that were too much to expect in a territory still overrun with such profound personal prejudices and imagined practical interests,—especially when the invaders are by nature so well-disposed towards the aboriginal enemy.

† *The Century Magazine*, Vol. LXVI., No. 2, pp. 294–302, June, 1903. Citation from p. 299.

out, the body all the while being rapidly drawn through this figure 8, so that the head and tail are constantly changing places, etc.

Surely these interesting phenomena are valued too much 'for the literary effects' to be got out of them; there is an unconscious *heightening* of the description, with the result that the eyes are described as 'closed,' whereas the snakes are characterized, and distinguished from the lizards, by the *absence of eyelids. Nor is there a nictitating membrane present.* Hence their eyes are set in a perpetual stare; although it is conceivable that their appearance might be (slightly) altered by certain movements, yet by no figure of speech could they be properly described as closed.* Mr. Burroughs's writings are of such service as to warrant correction; they are of such merit as to deserve it.†

While it is not my purpose here to sit in judgment *in re* Burroughs *vs.* Long, a characteristic difference between the two men may be noted, in passing, as it is revealed in their respective attitudes toward the great naturalists, Darwin and Wallace. Mr. Burroughs is always deferential, seeking, sometimes inadequately perhaps, to verify their results and to apply their conclusions, while Mr. Long distinctly implies that these observers labored under a serious disadvantage by reason of their limited opportunities for the study of animal life, as compared with his own unusual facilities, 'with Indian hunters' to his aid!*

The controversy between these gentlemen, as has been said, would not of itself warrant the sacrifice of so much space in your journal. "Where there is a manifest disproportion between the powers and forces of two several agents, upon a Maxime of reason, we may promise the Victory to the Superiour," as Sir Thomas Browne quaintly observes in his 'Religio Medici'; but, as he further reminds us, 'unexpected accidents' may 'slip in' and 'unthought of occurrences intervene,' which 'proceed from a power that owes no obedience to those Axioms' [of reason]. And surely in the case under consideration, such 'accidents' (if not 'unthought of occurrences') as popular prejudice, nourished by the indiscriminating leaders of the 'Christian Endeavorers of literature' and fed upon by shrewd publishers, have intervened, 'to make the worse appear the better reason,' and to gain, or momentarily to threaten to gain, the ascendency in the official instruction of youth.

In so far as I have seemed to take Mr. Long's case seriously, it has been only by way of warning, not against the particular extravagances of an individual, but against the unchecked diffusion of the false conceptions and meretricious standards, of which Mr. Long's teaching is typical and his following the unfortunate outcome. It is already too late and must needs be impossible, in our democratic civilization, for men of science to leave 'the public' out of account. If 'a little learning is a dangerous thing' for the individual, it assumes multiple proportions when the bulk of the community becomes infected. This business of popular education is in some respects a grand nuisance! It leads to a thousand blatancies—of bigotry, of cocksureness, of an assumed appearance of superiority without the reality, taking protean forms throughout the entire range of our public activities. Yet, on the whole, 'the greatest good to the greatest number' probably flows from just such an 'equality of opportunity'

* The anatomical fact alluded to might easily have been overlooked, but no knowledge of anatomy would have been necessary to a faithful record of *observed* fact. One of the ablest of our younger zoologists, and a college professor, when his attention was called to this curious statement of Mr. Burroughs, promptly replied in all seriousness, 'Perhaps he refers to the nictitating membrane'! Another zoologist humorously suggested that 'possibly the pineal eye was meant!'—but surely this hypothesis is barred by Mr. Burroughs's use of the plural.

† It is to be regretted, however, that Mr. Burroughs has brought *telepathy* into his animal psychology. See his article 'On Humanizing the Animals,' in *The Century Magazine*, Vol. LXVII., No. 5, pp. 773–780, March, 1904, especially pp. 776–777. One of the consolations of the comparative psychologist has always been his supposed freedom from the 'confidences' of the telepathists!

* See *The North American Review*, article cited, page 695.

as the diffusion of knowledge permits. All must be given a chance to breathe the fresh air, one must suppose, that the born 'saints' be not stifled; while, if 'saints' may be made, there must first be 'Christian Endeavorers' (to continue under the figure already borrowed from the editor of the *Atlantic Monthly*). Wherefore we still need our Mr. Mabies, even as our Mr. Mabies need improvement. We perhaps need even our Mr. Carl Snyders, but we certainly do not need our Mr. William J. Longs. We do need such delightful 'essay naturalists' as Mr. Burroughs; we need also professional naturalists who do not find it necessary to struggle against facts in order to develop or keep their individuality, but who try to make facts themselves attractive to both young and old; we need serious investigators in zoology and comparative psychology, who bring to their task 'an eye well practised in nature,' a mind exacting in its critical demands and furnished with a just knowledge of the results of previous workers, who are at the same time conscious of their obligation, as teachers, to a larger public. Above all, we need to-day, as much as ever, perhaps as never before, men whose attitude toward 'the people' resembles that of a Huxley or a Clifford, a Helmholtz or a Virchow, or that of many a lesser luminary, who by the popular exposition and inculcation of sound *principles* of science, have contributed effectively to the prevalence of light rather than darkness in the world, and, indirectly, at the same time, to the advancement of science itself.

And all these are needed (let it be stated whether *The Ypsilantian* thinks it 'nice' or whether it does not) in order that our children may be spared the painful necessity either of unlearning such pseudo-scientific fictions and anti-scientific prejudices as Mr. Long and his allies represent, or of growing up with minds perverted and ill adapted to survive as rational beings in a world of fact and law, though they struggle never so hard against both in the supposed interest of their individuality.

Wm. Harper Davis.
Columbia University.

## SPECIAL ARTICLES.

### THE ENCYCLOPEDIA AMERICANA ON ICHTHYOLOGY.

'The Encyclopedia Americana,' now being published, is in some respects a meritorious work, but great carelessness has been manifested in some of the office editorial work. Such is especially the case in one of the articles of the last volume (Vol. VIII.) which has come to hand. The article in question is 'Ichthyology' and its author is President David Starr Jordan. The text is excellent but the illustrations are very badly identified and could not have been submitted to Dr. Jordan. We may imagine the surprise and disgust of the author when he finds the erroneous and strange names applied to more than half of the cuts. Those most erroneously named are the following in regular sequence (the pages are not numbered):

*Homocercal tail.*—It is the tail of a *Polypterus* and consequently not homocercal at all but diphycercal.

*Port Jackson Shark* (*Cestraciontes*).—This is not the Port Jackson shark but the bull-head shark of California (*Gyropleurodus francisci*).

*Sting-ray* (*Raia*).—No species of Raia is a 'sting-ray' and the figure does not represent what is generally called a 'sting-ray,' but a fish of a very different family, the *Aëtobatus narinari.*

*Viviparous Perch.*—The name is altogether too indefinite and misleading, inasmuch as it is very far from any true perch; it is the embiotocoid *Cymatogaster aggregatus* of California.

*Elephant Fish* (*Chimæra*).—Not the true elephant fish but the ratfish of California (*Chimæra* or *Hydrolagus Colliei*).

*Gafftopsail Cat* (*Galeichthys*).—By no means, but the common channel cat of the United States (*Ictalurus punctatus*).

*Pike* (*Lucius*).—The fish figured is not at all related to the pike and belongs to a different order; it is a barracuda (*Sphyræna barracuda*).

*Butterfly-fish* (*Holacanthus*).—Not related to *Holacanthus,* but the common *Zanclus cornutus* of the Indo-Pacific region.

*Globe-fish* (*Tetraodon*).—It is the *Ovoides setosus*.

*Rose-fish* (*Sebastes*).—The *Sebastodes nigrocinctus* of California.

*An Antellarid.*—This is by no means an antennariid (as the word meant should have been written) but a ceratiid (*Caulophryne Jordani*).

*Bat-fish.*—As there are various fishes called bat-fish more definiteness is required than that name alone. The fish figured is the *Malthe vespertilio* of the eastern coast of the United States.

Surely it is a wrong to the public as well as to the author to give such work the wide circulation that the new encyclopedia will doubtless enjoy. The author of the article of course knows—none better—what are the right names to be attached to the figures and those given furnish sufficient evidence of the fact that the proof was not submitted to him —or at least that he did not correct it.

THEO. GILL.

## THE MINNESOTA SEASIDE STATION.

THE Minnesota Seaside Station party of 1904 will meet at the Hotel Dominion, Victoria, B. C., about the nineteenth of July. The precise date, depending upon the sailing of the steamer, *Queen City,* will be announced, to those who join the party, when the sailings are determined upon by the navigation company.

The party will proceed to the station and will remain in camp for one month, returning to Victoria in time to reach the east before the opening of the schools in September.

Owing to the impossibility of making agreements about railway rates at the present time, no announcement of a party from Minneapolis can be made thus early. In the past it has been an easy matter to get excursion rates during July so that the railway fare and sleeping car tariff between Minneapolis and Victoria may be estimated under $75. If a sufficient number join the station and desire the organization of a party to make the trip together, such organization will be undertaken and the trip will be made by one of the northern transcontinental routes with the usual stop-offs in the mountains.

The Minnesota Seaside Station is a biological camp and laboratory situated on the Straits of Fuca opposite Cape Flattery and in full view of the Olympic Mountains. The large log living house and the two laboratory buildings are upon the rocky and picturesque shore of the sea, while immediately behind there is the trackless forest of Vancouver Island with scarcely a human habitation. The combination of sea and forest and the absence of any of the distractions of the town make this camp one of the best spots in the country for study, recreation and health, as the hundred teachers and students who have visited it during the last three years can very well attest. During the season sunny weather is to be expected. There is an absence of noxious insects. One may sleep out of doors by driftwood fires and there is a sand beach with good bathing. Leisure moments can be occupied in cod or brook trout fishing, or in hunting.

The laboratories are equipped with microscopes and ordinary laboratory apparatus and during the month one can get a very complete introduction to a knowledge of the plants and animals of the shore. The configuration of the coast is favorable to the development of a varied fauna and flora. There are no restrictions placed upon legitimate collecting, and many of those who have visited the station have brought back large amounts of valuable botanical and zoological material. There are facilities for research and some important work has already been accomplished by members of previous parties.

An interesting feature at the station is lecture work conducted out of doors at various places within easy walking distance of the camp. Evenings are spent with informal talks upon biological or educational subjects or in song and story, sometimes in the large living room of the camp and sometimes around bonfires or mussel-bakes on the beach.

The botanical work during 1904 will be under the general direction of Professor Conway MacMillan, who will conduct special laboratory courses upon the ecology and morphology of the kelps and upon the anatomy and classification of the liverworts and mosses

of the region. Two courses upon algæ will be given by Miss Josephine E. Tilden and a course upon lichens by Dr. Albert Schneider, the author of the leading American text-book upon this subject. Dr. Schneider will also give some lectures upon bacteria and nitrogen assimilation. The name of the instructor in zoology, who will have charge of the zoological laboratory, can not be announced until later. Such courses as are provided are believed to be of the most value to the inland student visiting the seashore.

By special arrangement with the authorities of the University of Minnesota it is possible to accept work done at the seaside station by graduates of colleges as counting for credit towards the degree of master of arts.

The station fee which covers board, lodging, laboratory space, instruction, etc., at the station is $75 for the month. Those who expect to join the party are urged to send in their names as soon as possible in order that the director may know for how many to provide.

Descriptions of the station may be found in *The Popular Science Monthly* for January, 1902; the *Journal of Geography* for June, 1902; and *Nature* for December 18, 1902.

To those who join the party full instructions concerning all matters of detail will be furnished by letter.

Conway MacMillan,
Professor of Botany,
University of Minnesota,
Minneapolis, Minn.

## SCIENTIFIC NOTES AND NEWS.

The Bruce Gold Medal of the Astronomical Society of the Pacific has been awarded to Sir William Huggins for distinguished services to astronomy.

Principal C. Lloyd Morgan, of University College, Bristol, has been offered the honorary degree of LL.D. by the University of Wisconsin, but has been unable to accept the honor because he can not attend the ceremonies connected with the celebration of the fiftieth anniversary on June 9.

Congratulatory addresses will be presented on April 22 to Sir Henry Roscoe, the eminent chemist, on the occasion of the fiftieth anniversary of receiving the doctorate from Heidelberg University. The presentation will be at Manchester, Sir Henry Roscoe having been professor of chemistry at Owen's College from 1857 to 1887.

The following new members were elected by the American Academy of Arts and Sciences, of Boston, at the meeting of April 13, 1904: *As resident fellows:* Edward S. Sheldon and Herbert W. Smyth, both of Cambridge, Mass. *As associate fellows:* Eugene W. Hilgard, of Berkeley, Cal.; James D. Hague, of New York; Israel C. Russell, of Ann Arbor; Abraham Jacobi, of New York; and T. Mitchell Prudden, of New York. *As foreign honorary members:* Felix Klein, of Göttingen; Adolph Harnack, of Berlin; Pasquale Villari, of Florence; and M. L. Gaston Boissier, of Paris.

Cambridge University has resolved to confer the honorary degree of doctor of science on Wilhelm Ostwald, professor of chemistry in the University of Leipzig.

Lord Kelvin has been unanimously elected chancellor of the University of Glasgow in the room of the late Lord Stair.

The Paris Academy of Sciences has elected the following corresponding members: Professor Volterra in the section of geometry in the place of the late Professor Cremona; Dr. W. C. Brögger, professor of mineralogy and geology in the University of Christiania, in the section of mineralogy, in succession to the late Professor Karl von Zittel, and M. Charles Flahault, professor of botany in the University of Montpellier, in the section of botany, to succeed the late M. Millardet.

M. Santos Dumont has been made a chevalier of the legion d'honeur by the French government for his experiments with dirigible balloons.

Dr. Carl Duisberg, director of the Elberfeld Dyeworks, has been given the title of professor.

It is announced that Professor A. Graham Bell will give an exhibition of his tetrahedral kites before the National Geographic Society on April 30.

Professor Paul Hanus, who holds the chair of education at Harvard University, will be given leave of absence next year, and will spend the time making a study of foreign systems of school administration. Professor George Santayana, of the department of philosophy, will also spend the year abroad.

Professor Leverett Mears, Ph.D., of the chemistry department of Williams College, has been granted a year's leave of absence and will probably go abroad.

Professor H. C. Jones, of the Johns Hopkins University, has received a grant of $1,000 from the Carnegie Institution for research in physical chemistry during the year 1904–1905. The grant will be used for a research assistant, Dr. H. P. Bassett, who is now working at the Johns Hopkins University. This is a renewal of the grant which was made to Professor Jones for the year 1903–1904, and with which he received the assistance for the present year of Dr. F. H. Getman.

The Carnegie Institution has renewed its grant of last year of $500 to Professor M. Gomberg, of the chemistry department of the University of Michigan. This sum is expended for the payment of an assistant.

At the recent council meeting of the American Anthropological Association, held at the American Museum of Natural History, New York, Mr. George Grant MacCurdy was elected secretary of the association in the place of Dr. A. L. Kroeber, resigned.

Dr. Carlo von Marchesetti has been appointed director of the botanical gardens at Trieste.

Sir William Ramsay, of University College, London, will give the address at the next commemoration day of the University of Glasgow. His subject will be 'Joseph Black,' lecturer on chemistry 1756–66 in the old college, and enunciator of the doctrine of latent heat.

The death is announced, on February 4, of Dr. Kazuyoshi Taguchi, professor of anatomy in the medical faculty of the University of Tokio.

The second annual meeting of the South African Association for the Advancement of Science was opened at Johannesburg, on April 4, when Sir Charles Metcalfe delivered the inaugural address. Lord Milner occupied the chair.

Reuter's Agency is informed that the British Antarctic vessel *Discovery*, with Captain Scott and his staff, is not likely to return to England before the autumn. Some little time will be spent at Christchurch in repairing the vessel, after which Captain Scott will enter upon the work of taking a line of soundings between New Zealand and Cape Horn. It is expected that the relief ships *Morning* and *Terra Nova* will sail direct for home.

The Goldsmith's Company has given £1,000 to the Royal Society for research on radium and radio-active bodies.

The Institute of France has received a bequest from M. Jean Debrousse, yielding an annual income of about $6,000. A thousand dollars has been appropriated for the publication of a lunar table.

Professor J. H. van't Hoff has placed at the disposal of the *Zeitschrift für Physikalische Chemie* the sum of $300 for prizes for papers on the literature of the phenomena of catalysis. The papers may be published in the journal and must be received before June 30, 1905.

The Royal Astronomical Society is making a collection of portraits of its past presidents, and has recently received from Sir Robert Ball a portrait of Professor Brinkley; of Manuel Johnson, who was Radcliffe observer in the middle of the last century, and of Dr. Rambaut.

The U. S. Civil Service Commission announces an examination on April 19–20, to secure eligibles to fill a vacancy in the position of assistant (male) in the Nautical Almanac Office, at $1,000 per annum, and other similar vacancies as they may occur. The commission also announces an examination on May 11–12, 1904, for the position of assistant biologist (male) in the Division of Biological Survey, Department of Agriculture, at $1,200 per annum.

The Lake Laboratory announces courses of instruction in various branches of zoology and

botany for the summer of 1904. As in previous years, provision is made for the accommodation of investigators, no fee being charged to those who do independent work, but each investigator being expected to furnish his own microscope or any special apparatus required unless otherwise arranged. The laboratory building completed last summer is beautifully located on Cedar Point across the bay from Sandusky and furnishes very advantageous opportunities for study and research. Persons enrolled at the laboratory are given free transportation on the steamers of the Cedar Point Resort Company. This makes it very convenient to visit neighboring localities and permits a wide choice in living. The enrolment for last summer included teachers and students from a number of colleges and universities, chiefly in the central states. Announcements and full information may be secured from the director, Professor Herbert Osborn, Ohio State University, Columbus, Ohio.

The magnetograph records of the Magnetic Observatory of the Coast and Geodetic Survey, situated at Cheltenham, Maryland, showed effects apparently to be attributed to two recent earthquakes, one of which occurred in the state of Washington and in British Columbia on the night of March 16, and the other in New England, in the early morning of March 21. The curve showing the variations of the magnetic declination revealed three faint but distinct seismic disturbances on March 16 at $10^h53^m$, $10^h59^m$, $23^h03^m$ P.M., eastern time, the first being the most pronounced. On March 21, the same curve showed a very plain seismic disturbance at $1^h08^m$, eastern time. The times in both instances are in fair agreement with the reported times in the newspapers. In neither instance were the horizontal and vertical intensity curves affected.

The Canadian Government has purchased for $75,000 the steamer *Gauss*, which was built three years ago for the German Antarctic expedition at a cost of $125,000. She is to be commanded by Captain Bernier, and will be employed at once in conveying relief stores and coal to the government steamer *Neptune*, at present wintering in Hudson Bay. Subsequently she will be engaged in survey work on the coast of Labrador. It is said that Captain Bernier hopes to be able to utilize the *Gauss* in 1905 in an attempt to reach the North Pole from Canada.

The directors of the Manchester Chamber of Commerce have resolved to urge upon the city corporation that in the interest of the general wellbeing of the district a municipal industrial and commercial museum should be established and constantly replenished for the purpose of exhibiting permanently the raw materials and manufactures of British Colonies, India, and foreign countries. Such an institution they regard as an invaluable means of instruction as to the requirements and economic situation of other countries, and as an authoritative source of information as to the customs and habits of their peoples.

A correspondent writes to the London *Times* that it is officially announced that the secretary of state for India has sanctioned the decision of the government of India to establish an agricultural research station, with an experimental farm and an agricultural college, at Pusa, in the Darbhangah district of Bengal, and to devote to the purpose the donation recently entrusted to the Viceroy by Mr. Henry Phipps for some object of public utility, preferably for scientific research. The farm is to serve as a model for similar institutions under provincial governments, some of the existing institutions being in need of improvement. Lines of experiment are to be initiated and tested before being recommended for trial under local conditions on the provincial farms; seed of improved varieties will be grown for distribution in the different provinces; results reported from other farms will be tested; scientific research work will be carried on; and practical training will be given to students at the college, which is to be known as the Imperial Agricultural College. The students' course will be one of five years, and it will be open to young men from all parts of India. The government will look to the institution to provide them with teachers of agricultural subjects, with managers of experimental or demonstration farms, and with officers of the Court of Wards. At the same time the trained

staff and laboratories at Pusa will provide facilities for the application of higher science to those agricultural problems the importance of which to the welfare of India and its people can hardly be exaggerated. Mr. Bernard Coventry, manager of the Dalsingh Serai estate, has been appointed principal, and enters upon his new duties forthwith, but the college will not be ready to receive students until August or September of next year.

The five-foot equatorial telescope, with Newtonian and Cassegrain mirrors, and many other astronomical and optical instruments belonging to the late Dr. Common, are offered for sale by T. A. Common, 88 Wigmore Street, London, W.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

The Drapers' Company, in addition to their previous gift of £10,000, have promised £5,000 to the building fund of University College, Cardiff.

The secretary of state for India has vetoed the proposal to abolish the engineering college at Coopers Hill, the proposal having been warmly opposed by the government of India, and by the Departments of Public Works, Forests and Telegraphs, which are recruited from the college.

According to *The British Medical Journal,* the total number of students attending the French universities is 30,405, made up as follows: Paris 12,985, Aix-Marseille 1,080, Besançon 333, Bordeaux 2,320, Caen 752, Clermont 299, Dijon 880, Grenoble 705, Lille 1,164, Montpellier 1,707; Nancy 1,327, Poitiers 863, Rennes 1,190, Lyon 2,069, Toulouse 2,291. The Arts Faculty has 4,384 students, of whom 3,873 are French. It has 613 women students. Law has 10,972 students, and of these 4,382 belong to the University of Paris and 1,021 to Toulouse. In the Faculty of Science there are 4,765 students, of whom 1,546 attend the Paris Faculty, 552 that of Lyon, and 476 at Nancy. There is a total of 6,686 students of medicine, of whom 6,115 are French. They are distributed as follows: Paris 3,496, Lyon 958, Bordeaux 654, Montpellier 552. There are 571 foreigners attending this Faculty, of whom 197 belong to Persia, 89 to Turkey, 63 to Bulgaria, and 57 to Roumania. To these must be added 202 French women students and 164 women students from abroad, together with 1,558 students who are taking the course of medicine and pharmacy. Besides these there are 3,014 students of pharmacy.

Mr. J. G. Jack will conduct a field class at the Arnold Arboretum on Saturdays during the spring and early summer, to assist those who wish to gain a more intimate knowledge of the native and foreign trees and shrubs which grow in New England.

At a meeting of the trustees of Columbia University, on April 11, the heads of the departments of civil, mechanical, electrical and mining enginering and of metallurgy were assigned to seats in the faculty of pure science. Dr. William T. Bull, professor of surgery, tendered his resignation, to take effect on June 30.

The senate of London University has resolved to establish a degree in veterinary science in the faculty of science.

At Harvard University Dr. C. L. Bouton has been appointed assistant professor of mathematics and Mr. G. S. Reyner, assistant professor of mining; Dr. H. W. Morse has been appointed instructor in physics.

Miss Mary Perle Anderson, who had charge of the instruction in nature study in the summer session at Columbia University in 1903, has been appointed instructor in botany at Mt. Holyoke College for the coming year. Miss Anderson has recently received the first prize for an essay on the preservation of native plants awarded by the New York Botanical Garden.

Mr. Sidney Skinner, M.A., of the Cavendish Laboratory, and director of natural science studies at Clare College, Cambridge, has been appointed principal of the Southwestern Polytechnic, Chelsea.

Mr. W. L. Symes, M.R.C.S., has been appointed scientific assistant in physiology at London University. Mr. John Herbert Parsons has been awarded the degree of doctor of science in physiology as an external student.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 29, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## THE NORTHEAST COAST OF BRAZIL IN ANCIENT CARTOGRAPHY.*

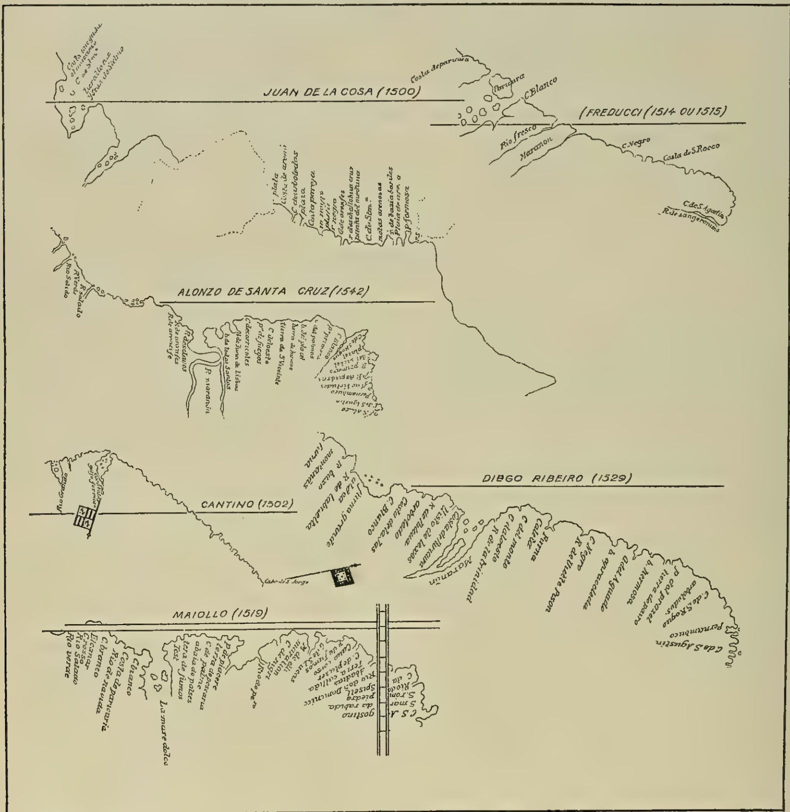
THE publication of the great atlas containing reproductions of almost all the known old maps of Brazil that accompanies the exposition of the Brazilian representative, Baron Rio Branco, to the arbitrator in the question of the limits of Guyana, makes possible, for the first time in Brazil, the study of the ancient cartography of that country. Having applied myself to this study in a recent paper entitled 'Os Mappas mais antigos do Brasil' published in Vol. VII. of the *Revista do Instituto Historico de São Paulo,* I verified the possibility of amplifying and correcting the scanty written documents relative to the first epoch of Brazilian history, and being invited by Baron Studart to contribute to the commemoration of the first settlement of the state of Ceará, it seemed to me that I could best respond to his intentions by making a similar study of the portion of the coast to which that state belongs. Both geographically and historically this portion is limited on the south by Cape Santo Agostinho and on the north by the mouth of the Amazonas, and to this section the present study will be exclusively devoted.

In the above-mentioned paper I treated summarily of this section in the analysis of the map of Juan de la Cosa of 1500 in which it was for the first time represented on the basis of the data furnished by the explorations of Vicente Yanez Pinzon and

* Translated from the memorial volume of the tricentennial of the state of Ceará, Brazil.

Diogo de Lepe, which were made in that same year. I now propose to make a more detailed study of this precious document and of the maps that followed it.

A careful examination of the map of Juan de la Cosa indicates that the author had detailed information regarding the section of the coast from a point a little to the west of Cape S. Roque to the mouth of the Orinoco, where his own observations, as a member of the expedition of Hojeda in 1499, commenced. The relatively accurate configuration of this section, the presence of names and the placing under the equator of the great indentation that undoubtedly represents the mouth of the Amazonas indicate with almost absolute certainty that this part of the map was copied from an older map (a prototype in the phrase of Harrisse) based on the observations of one or more of the first navigators that had coasted along it. The



point where this prototype commenced is clearly indicated by the beginning of the nomenclature in front of the figure of a Spanish ship, by the inscription referring to Pinzon and by the perfunctory character of the drawing to the southward of the bend of the coast that represents Cape S. Roque.

Judging exclusively by the map, one would say that the characteristic configuration of the coast in the neighborhood of this cape was recognized by one of the first discoverers, but that he only landed to the west of this point at the mouth of a river of which the name has been destroyed by a rent in the paper of the map. The first letter of this name is an *S*, which seems to indicate a denomination taken from the saints' calendar. Following comes a series of sixteen names to another rent in the paper, indicative of a detailed examination of the coast, to which was applied denominations that for the most part are simply descriptive. Amongst these the most significative is 'rio de sefallohuacruz' (river where a cross was found), which indicates that the author of the name was preceded by another christian. The only name of this series that is not descriptive is 'C.º de stm.ª' (Cape Santa Maria), taken from the calendar and probably indicative of a date, and with regard to which it should be noted (as Harrisse has already observed) that it belongs to a group of names written in a different hand from that of the body of the map. Beyond this first series of names another rent in the paper, in a position that includes the gulf of Maranhão,* has perhaps destroyed some other names. Following comes a considerable stretch of coast without names but with a pronounced topographical feature in the drawing in the strong indentation of the coast line, that presumably represents the southern mouth of the Amazonas, or Rio Pará. Another indentation with a group of six names and placed under the equator undoubtedly represents the main mouth of the Amazonas designated by the names of 'g.º de Stm.ª' (Gulf of Santa Maria) and 'elmacareo' (pororóca or bore).

* Maranhão, and Maranham are different modes of writing the same Portuguese word, the first form being the one usually employed in modern writings.

The conclusion to be drawn from the study of the map is that this part of the coast was explored by two discoverers and afterwards represented by Juan de la Cosa on the basis of a prototype embodying the observations of one or the other, or both, of whom the second registered the finding of a cross set up by the first. These explorers, or one of them, seem to have sighted the coast near Cape S. Roque, so as to have perceived its inflexion to the south, but to have only landed to the west of this cape, and to have followed the coast closely throughout a certain section, noting and naming all its details, to afterwards sail farther out before landing again at the mouth of the Amazonas.

Another map almost contemporary with that of Juan de la Cosa and presumably based on the results of the same explorations is the one organized in Lisbon in the year 1502 by order of Albert Cantino. In the above-mentioned paper, in which the South American part of this map is reproduced, I presented reasons for believing that it was in great part compiled from information gathered from sailors in the port of Lisbon rather than from preexisting maps. Thus for the southern coast of Brazil there are indications of slightly detailed information relative to the Portuguese expedition of 1501, the author, on his own account, substituting the name 'Cape São Roque,' given by that expedition by 'Cape St. George,' probably in commemoration of the date of discovery of Brazil at Porto Seguro by Cabral.

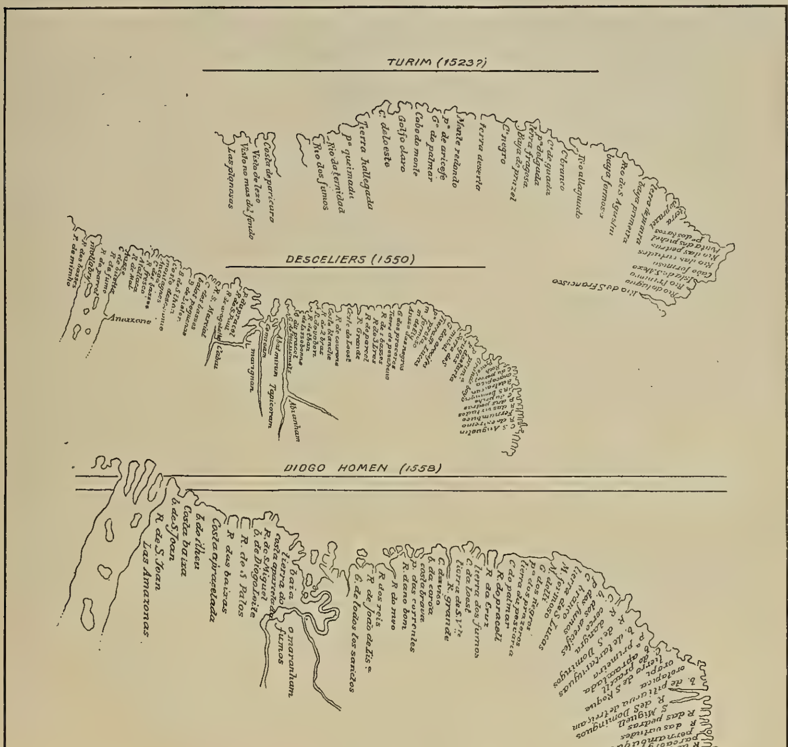
In the section here considered the Cantino map is without details and names, with the exception of two great gulfs which seem to represent that of Maranhão and the mouth of the Amazonas. The first bears the inscription 'Canabales. Golfo fermoso' (Canabals. Gulf fermoso), and the second that of 'rio grande' and, in front, 'todo este mar é agua doce' (all this sea is fresh water). From this it may be concluded that one of the explorers of 1500 entered the gulf of Maranhão and had here an encounter with the Indians.

In the configuration of the coast the Cantino map gives an almost northeast direction to the section between Cape S. Roque and the mouth of the Amazonas, thus throwing the latter far to the north of the equator. This defect reappears in many of the early maps, especially those printed in Germany, which evidently took this Cantino map, or some of its derivatives, as a prototype.

A new exploration of this coast is apparently indicated by the map reproduced in the text (p. 84) of Rio Branco's second memoir where it is attributed to Count Ottomano Freducci and to the year 1514 or 1515. For the section to the south of Cape S. Roque the prototype of this map was evidently a simplified copy of the Portuguese map of 1502, or some other one similar to it; and for the section to the north of the Amazonas, a Spanish map similar to those mentioned below of Maiollo, the Turin map or that of Diego Ribeiro, and which was not that of Juan de la Cosa. The intermediate section, however, presents special characteristics which may be either Portuguese or Spanish. Among the four names of this section 'c. negro' recalls the 'r. negro' and 'm. negro' of the Juan de la Cosa map, but 'maranon,' 'rio fresco,' 'c. blanco' and 'paricura' are entirely new. It is worthy of note that the topographical drawing, which is generally perfunctory, represents two rivers near the name Maranon and a large island dividing the mouth of the Amazonas, thus being in this respect remarkably accurate.

The Maiollo map of 1519 evidently had substantially the same prototypes as that of Freducci for the sections to the south of Cape S. Roque and to the north of the Amazonas, but another one for the section here considered. As its rich nomenclature is Italianized it is difficult to say if it was originally Portuguese or Spanish, but the use in two places of 'fumos' instead of 'humos' indicates the former. The extreme eastern point of the continent figures with the name of 'c. de spicell' (c. de S. Miguel?), S. Roque ('s. rom' on the map) being placed to the southward of a new name 'Rio de piedre' which is probably the Rio Goyana. These new names of 'Cape S. Miguel' and 'Rio das Pedras,' which appear to the south of Cape S. Roque (like 'Pernambuco' and 'Rio das Virtudes,' which appeared almost simultaneously in maps of 1518 and 1523), probably come from Portuguese navigators who explored the southern part of the continent, those of the new prototype beginning to the west of the Cape Spicell of the map. Amongst these last are 'c. denigri' and 'maralion' that are probably identical with the 'c. negro' and 'maranon' of the Freducci map, though the latter name is placed to the eastward of the feature in the drawing that undoubtedly represents the gulf of Maranhão. Discharging into the latter is a 'Rio de pe$^{re}$' which like 'cauo corco' is a significative name to which we shall return later. It is to be noted that in his later map of 1527 Maiollo emended the nomenclature of the coast between Cape S. Roque and the mouth of the Orenoco making it correspond almost exactly with that of the Freducci map, with which he had evidently become acquainted in this interval of time.

Another Italian map known by the name of 'The Turin Map,' and attributed to the year 1523, bears a rich nomenclature different from that of those above mentioned, and one most decidedly of Portuguese origin. Amongst the 24 names in the section in with the name of 'Golfo Claro,' while the mouth of the Amazonas is without special denomination, though clearly indicated in the drawing, and with the characteristic name of 'Costa de paricura' in the northern margin.




ESTAB GRAPH. "STEIDEL" S A S PAULO

question only two (c. negro and rio dos fumos) present similarity with those of the Maiollo map. The topographical drawing is perfunctory, the gulf of Maranhão being indicated only by a slight indentation

The map of Diego Ribeiro, Royal Cosmographer of Spain, of 1529, bears the express declaration that the coast between the Rio Dulco (Orinoco) and Cape S. Roque contains nothing of profit, and that having

been coasted along once or twice soon after the discovery of the Indias (America), no one returned to it. This declaration indicates that in the official Spanish department (Casa de la Contratacion of Seville) especially charged with the gathering of information regarding voyages and discoveries, maps already known in Italy, like those on which Freducci, Maiollo and the author of that of Turin based their work, were either unknown or overlooked. According to this declaration the prototype for the section here considered must have been a map representing the discoveries of Pinzon and Lepe, but differing in the drawing and in the nomenclature from that of Juan de la Cosa. On a comparison of the two it appears that Diego Ribeiro identified the Amazonas (with the name of Maranon) with the first great indentation, or Rio Pará (?) of the map of Juan de la Cosa, reducing the second to a bay full of islands, and with the name of 'furna grande.' Thus is explained the erroneous placing of the mouth of the great river to the southward of the equator, which persisted for a long time in the Spanish maps (or those derived from them) and introduced great confusion in geography. The gulf of Maranhão (with the name of 'furna') is of slight prominence in the Ribeiro map, but is well placed with reference to the southern mouth of the Amazonas, and is figured with the characteristic entrance of two rivers at the head. 'C. negro' is the only name that can be positively identified on any preceding map, including that of Juan de la Cosa. The name 'R. de uicête pison' appears to be an interpolation made by the cartographer in his prototype, in commemoration of the first discoverer. Other map-makers, commencing with Freducci, made a similar interpolation, but in the section to the north of the Amazonas, and this use prevailed, giving as a result the well-known complication of the Oyapock question between Brazil and France. The absence in this map of characteristic Pinzonian names is a notable fact which perhaps indicates that its prototype was based principally on the voyage of Lepe.

The maps that succeeded that of Diego Ribeiro, commencing with one dated 1534, indicate the introduction, for the section in question, of a new prototype of Portuguese origin; and it is a notable fact that this served for many years as a prototype for maps of all origins, Portuguese, Spanish, French and Dutch. This new prototype must therefore have been based on a Portuguese exploration made between the years 1529 and 1534. The original maps based on this prototype are the Spanish ones of Alonzo de Chaves (Padron Real of 1536), Alonzo de Santa Cruz (1542), Sebastian Cabot (1544) and Diego Gutierrez (1550, 1562); the French ones of Nicolas Desliens (1541) and Pierre Desceliers (1550); the Portuguese ones of Gaspar Viegas (1534), Diogo Homen (1558, 1568), André Homen (1559), Lazaro Luiz (1563), Bartholemeu Velho (1564) and Fernão Vaz Dourado (1568, 1571 and 1580), and the Dutch maps in great number derived from one or another of the preceding, but for the most part from that of Gutierrez of 1562 and of Bartholemeu Velho of 1564.

The characteristic of this prototype by which it can be identified in all of its reproductions is the topographical design of the gulf of Maranhão and of the rivers that discharge into it. The nomenclature is characterized by the preservation of a good part of the names of the Maiollo map (probably indicating that the explorer followed the coast with this map, or a derivative from it, in hand) and by the introduction of many new Portuguese names, amongst which that of Diogo Leite is especially significant, as it may be presumed to be that of the explorer himself.

Not having at hand the oldest of these maps (that of Gaspar Viegas of 1534*), we take as presumably the most complete and accurate of the reproductions of this prototype, that of Diogo Homen for the nomenclature, and of Pierre Desceliers for the topographical design of the neighborhood of Maranhão. This last map is also interesting as showing that notwithstanding its date posterior to the voyage of Orellana down the Amazonas, the drawing was made before this event, the river being interpolated (and erroneously) in a design that figured a continuous coast line to the northward of the gulf of Maranhão. The same interpolation, but more artfully made, is to be noted in the Desliens map, while Alonzo de Santa Cruz (and undoubtedly also Alonzo de Chaves in his lost Padron Real), not knowing the Amazonas of Orellana, adjusted the new prototype to the old maps by suppressing the Amazonas and identifying the 'Rio de la Mar Dulce' of Pinzon (to which the Spaniards had applied the name of 'Maranon') with the gulf of Maranhão of the Italian cartographers and of the new Portuguese explorer. Other Spanish cartographers (Cabot and Gutierrez) resolved the difficulty by hashing the drawing and nomenclature of the new prototype to the west of Maranhão. From this resulted the confusion and discordance of the early maps that figured so largely in the discussion of the limits between Brazilian and French Guyana, without their origin being discovered on account of the loss of the Padron Real of Alonzo de Chaves from which they proceeded. The recent publication in Sweden of the map of Alonzo de Santa Cruz, which is essentially a reproduction of the Padron Real, clears up the matter perfectly, showing that in a group of maps antedating the voyage of Orellana there was a total suppression of the Amazonas, which had afterwards to be restored confusedly.

In view of the circumstances above indicated we have selected for reproduction the maps of Diogo Homen, Desceliers and Alonzo de Santa Cruz. The others give more or less diversified variances of the same theme.

In studying this prototype one is impressed with the relatively minute and accurate representation of the hydrography of the basin of the gulf of Maranhão (far superior, for example, to the representation given by the famous Sebastian Cabot to the River Plate basin where he had been for four years), and by the introduction of a group of Indian names of which some (Itapicurú and Pindaré) have been preserved to the present day. This seems to indicate that the explorer found here an European domiciled amongst the Indians and well acquainted with the topographical details of the region. This supposition is, to a certain extent, confirmed by the fact that the only other indigenous names are found grouped between Pernambuco and Cape S. Roque, where the Europeans had been for some years in contact with the Indians so as to have become somewhat acquainted with their language.

The topographic design of the reproductions of this prototype in the maps of Diogo Homen and Desceliers is sufficiently detailed to permit the identification of some of the more salient features, and, based upon these, we can attempt that of the names as follows, taking them from the

* This map preserved in the National Library of Paris is, according to the note by Harrisse (*op. cit.*, p. 599), a nautical chart representing, in the Brazilian part, the coast from two or three degrees to the west of Maranhão to about two degrees to the south of the La Plata estuary. With reference to it Ferdinand Diniz (cited by Harrisse) says: "Captain Mouchez who had been charged by the French government with the continuation and improvement of the work of Admiral Roussin (the marine chart of the coast of Brazil) was like myself astonished by the relative accuracy of this geographical monument."

map of Diogo Homen which best preserves their original Portuguese form:

*C. de S. Agostinho.*—This name originated with the Portuguese expedition of 1501, which also used the name of 'C. da Santa Cruz' for the same feature.

*Parcarohy.*

*R. do Extremo.*—On the plausible hypothesis that the 'Pernambuco' of the map was situated to the north of the present city, this would be the river Capibaribe.

*Pernambuquo.*—This name in the form 'Pernambua' appeared for the first time in a Portuguese map referred to the year 1518.

*R. das Virtudes.*—Probably the canal of Itamaracá.

*R. das Pedras.*—Rio Goyana. This name appears for the first time in the Maiollo map of 1519, but dislocated to the north. Sebastian Cabot went, in 1526, from Pernambuco to the Rio das Pedras to take water, passing by the Rio das Virtudes, which apparently was not suitable for the purpose. This last name appears in the Turin map of 1523.

*S. Miguell.*—Another map by Diogo Homen, dated in the same year, has instead 'c. de spicell,' which had already appeared in the maps of Maiollo and of Turin. This seems to be Cape Branco to the south of Parahyba.

*R. de S. Dominguos.*—Rio Parahyba.

*B. de Pitiacua de treicam.*—Bahia da Traição (Bay of the Ambuscade). The name probably refers to some historical event before 1534, as it appears in the Chaves map in the form of 'Epitiaca,' and in that of Viegas as 'b. da treiçam.' The name is generally attributed to an event that took place in 1556, but erroneously, as these maps prove.

*Orotapica, Orapi.*—These two names in the vicinity of the city of Natal (Rio Grande do Norte) are the last of a group of Indian names that extend from the Cape S. Agostinho, and probably indicate that to this point extended the more or less friendly relations of the whites with the Indians.

*Tierra de S. Roque.*—In the vicinity of the cape of the same name.

*C. do Parcell.*—Probably the Cape Calcanhar, the extreme point of the continent.

*B. Apracelada.*—(The bay of reefs.)

*P^a. Primeira.*—(The first point.)

*B. de Tartarugas.*—(Turtle Bay.) Bahia de Aguamaré (?) The Desceliers map has 'Grande baya' but before the Ponta Primeira.

*R. de S. Domingos.*—Rio Açú (?)

*R. Dangra.*—Rio Mossoró (?)

*C. Corco.*—This name appears first in the Maiollo map of 1519 and continues to that of Brué of 1834, where it is identified with the Ponta do Retiro Grande between the mouths of the Mossoró and Jaguaribe. The Desceliers map gives here 'Serres de S. Michel,' a name that persisted until after the Dutch invasion.

*R. dos Arecifes.*—(River of Reefs.)

*R. dos Fumos.*—(Smoke River.) This name appears in the Maiollo map. It is probably on the coast of Aracaty in Ceará.

*C. Branco.*—Ponta de Mucuripe (?)

*Tierras de S. Lucas.*—Vicinity of Fortaleza (or Ceará) (?) The name is applied to a gulf in the Maiollo map.

*M. Fermoso.*

*M. Delli.*—The other map of the same year by Diogo Homen gives 'M. dely'; Maiollo, 'M. de elli.' It is probably the Serra de Mamamguape which, though situated in the interior, is an imposing feature of this part of the coast. Maiollo places close by the name 'Maralion.'

*G. dos Negros.*—Gulf of Ceará (?). This is in the region of the 'r. negro' and 'm. negro' of the Juan de la Cosa map. The 'C. Negri' of Maiollo and the 'c. negro' of the maps of Freducci, Turin and Diego

Ribeiro appear to be more to the west in the neighborhood of the river Parnahyba.

*Pta. dos Prazeres.*—(Point of Pleasures.)

*Tierra da Pescaria.*—(Fishing grounds.)

*C. do Palmar.*—(Cape of the Palm Groves.)

*R. do Pracell.*—(River of the Reef.) Rio Acaracú (?)

*R. da Cruz.*—(River of the Cross.) This name appears to be preserved to the present day for one of the rivers discharging into the bay of Camocim. It is probably the 'R. das 3 bras' of the Desceliers map, although this name comes before the 'R. do pracell.'

*Tierra dos Fumos.*—(Land of Smoke.)

*C. da Loest.*—(East (?) Cape.)

*Tierra de S. Vte.*—(S. Vincent's Land.)

*R. Grande.*—Rio Parnahyba.

*C. Daviso.*—(Advise Cape.)

*B. da Coroa.*—(Bay of the Sandbank.) Bahia de Tutoya (?).

*Costa Brava.*—(Wild Coast.) 'Coste blanche' on the Desceliers map. Costa dos Lençoes.

*P. das Correntes.*—(Point of the Currents.) Ponta Mangaes Verdes.

*R. Danobom.*—(Rio de Anno Bom = New Year's River.) The Desceliers map gives 'R. de vobom'; Chaves and other Spanish maps, 'R. de Naubom.'

*R. do Meo.*—(Middle River.)

*R. dos Reis.*—(River of the Kings.)

*R. do João de Lisa.*—(John of Lisbon's River.) Rio Piria (?), or perhaps the Rio Monim.

*G. de Todos os Sanctos.*—(All Saints' Gulf.) Bahia de São José, southern part of the Gulf of Maranhão.

*O. Maranham.*—Almost all of the old maps employ the name in this manner with the article *o* or simply without any qualifying term.*

*Abatimirim.*—This and the four following names come in the Desceliers map, but not in that of Diogo Homen.

*Tapicoram.*—Itapicurú (river).

*Abiunham.*—This name also appears in the map of Bartholomeu Velho where it seems to be applied to the river Parnahyba.

*Camicam.*—The other Diogo Homen map gives 'Acencam' (Ascension).

*Cabai.*—On an affluent of a river without name that represents the Grajanú. This affluent represents very well the river Pindaré, and the name 'Pinare' appears in the Gaspar Viegas map of 1534 and in the anonymous map of the Riccardiana Library.

*Baia.*—(Bay.) On the northern margin of the Gulf of Maranhão. On the Diogo Homen map of 1568 the name is 'b. grelo' or 'b. grela.' In the same position Vaz Dourado has 'Almadias.' It is at present known as the Bay of Itacolumy.

*Tierra dos Fumos.*—(Land of Smokes.)

*Costa Aparcellada.*—(Coast full of reefs.)

*R. de S. Miguel.*—'R. de S. Paul' on the Desceliers map. Rio Turyassú.

*B. de Diogo Leite.*—Bay of Turyassú. It is probable that the name is that of the commander of the exploring expedition.

*R. de S. Palos.*—'R. S. Marcial' on the Desceliers map. Rio Maracassumé.

*R. das Baixas.*—(River of the Shoals.) Rio Gurupy.

*Costa Apracellada.*—The other map of Diogo Homen of 1558 has here 'pa da costa suja' (Point of the Dirty Coast), which comes from the Viegas map of 1534 and is reproduced in many of the old maps.

* This manner of using the name is very suggestive of a topographical term. The Portuguese language has in its marine topographical terminology the term 'o marachão' (an artificial or natural barrier of sand or gravel) which would be very applicable to this section of the coast and which might readily be transformed into 'o maranhão.' In fact the dictionary of Moraes cites an old author who gives (by error, says the lexicographer) 'maranhões' for 'marachões.'

*B. de Ilheu.*—(Bay of the Islander, or native of the Azores.)

*Costa Baixa.*—(Low Coast.)

*B. de S. Joan.*—Bahia da Bragança (?).

*Costa Descoberta.*—(Open Coast.) This name, which comes on the other map of Diogo Homen, is given as 'Coste desconnue' on that of Desceliers.

*B. de S. Joan das Amazonas.*—Rio Pará or southern mouth of the Amazonas. The last part of the name is evidently an interpolation after the voyage of Orellana. At this point the Desceliers map emends the new Portuguese prototype with an old Spanish map eliminating the Amazonas and the nomenclature of this prototype to the mountains to the north of the Oyapock. A similar elimination occurs in the maps of Alonzo de Chaves and Alonzo de Santa Cruz.

To the north of the mouth of the Amazonas the Diogo Homen map has the old nomenclature of the Spanish maps mixed with some new names (B. de muchas ishas, R. de Nuno and R. del Casique), which indicate a new exploration of this part of the coast. As these names appear in the map of the Riccardian Library this exploration must have been before the year 1543.

Combining the deductions that can be legitimately drawn from the study of these maps with the scanty data of the written history, we may now attempt a restoration of the story of the discovery and delineation of this portion of the coast. For this purpose we shall make use, as regards the historical data, principally of that carefully collected and verified by Harrisse in his great work entitled 'The Discovery of North America.'

Vicente Yanez Pinzon, setting out from Spain towards the end of 1499, sighted a cape, which he denominated 'Santa Maria de la Consolacion,' towards the end of January (20th or 26th, according to the chroniclers; 2d of February if the name indicates a date) of 1500. A few days afterwards he landed and executed acts of possession, including the planting of a cross on a point that he denominated 'Rostro Hermoso,' perhaps for being on the 4th of February, feast of the Veronica which in an old Spanish calendar is denominated 'Rostro Hermoso.' Continuing his voyage, Pinzon entered the mouth of the Amazonas, which he called 'Santa Maria de la Mar Dulce,' probably on account of being here on the 25th of March, feast of the Annunciation. Entering a few leagues in the great river, which he called 'Marina tâbalo,'* he had an encounter with the Indians. Continuing to the northward, he gave the name of 'S. Vicente' to a cape which he probably passed on the 4th of April, and arrived at Hespaniola on the 23d of June and at Palos in Spain on the 30th of September.

The Cape Santa Maria of Pinzon should be relatively well placed on the Juan de la Cosa map, and in this case it must be some promontory to the west of Cape S. Roque on the coast of the present states of Rio Grande do Norte or Ceará, his Rostro Hermoso being some leagues farther on. Varnhagen quite plausibly identified Cape Santa Maria with the Ponta do Mucoripe and the Rostro Hermoso with the Ponta Jericoácoára.

Diego de Lepe, starting from Spain shortly after Pinzon, took the same course and sighted the land at about the same point, whence steering eastward, he coasted along until he perceived the southward bend of the coast in the vicinity of Cape S. Roque, but, notwithstanding the affirmation in 1513 of his companions to the contrary, did not double the cape. Turning about, he landed at the mouth of a river that he named 'S. Julian,' which is per-

* May not this be a reference to the pororóca (bore), Marina tâbalo being a corruption of 'Marina-tambales' (Agitated sea)?

haps the partially destroyed name on the Juan de la Cosa map that commences with the letter *s*. Continuing westward, Lepe found the cross left by Pinzon, and entering the gulf of Maranhão, found the Indians there to be cannibals (see the Cantino map), perhaps through the loss of some companions, of whom one probably remained alive amongst the savages. Afterwards, leaving the coast so as no longer to be able to see and name its details, he entered the mouth of the Rio Pará and of the Amazonas proper, and, coasting northward, met Pinzon in the gulf of Paria. Before the 9th of November of 1500 Lepe had returned to Spain, but, as it appears, the greater part of his crew had returned some months before. Two of Lepe's companions, and perhaps the whole expedition, were in Hespaniola in February or March of 1500, where they met Juan de la Cosa, who was in the expedition of Hojeda.

Juan de la Cosa, being in Spain between the months of June and October of 1500 in the interval of two voyages, organized his celebrated map, or more probably contributed the American part to a map already made (in another style and with more elaborate ornamentation) by others, in the parts relating to the other continents. As Pinzon only arrived in Spain towards the end of September, it is almost certain that the section of the coast to the south of the Orinoco was drawn from data furnished by the companions of Lepe who had arrived in June without their commander. Thus, as has already been deduced above from the internal evidence of the map itself, it is probable that this map represents essentially the configuration and nomenclature given by Lepe, and probably communicated by one of his companions. In this way is explained the absence in the map of the names 'Santa Maria de la Consolacion, Rostro Hermoso, Santa Maria de la Mar Dulce, Rio Marina-tâbalo and Cabo San Vicente,' which in the following year were employed in the Capitulacion Real to designate the concession given to Pinzon, and which, being undoubtedly furnished by him as characteristic of his discovery, should necessarily figure in any map directly inspired by him. It seems probable, however, that the two names of 'Santa Maria' indicate a revision of the map by some companion of Pinzon. In view of the abbreviated form of these two names and the complete lack of the others, it is hardly probable that their interpolation in the map, already almost completed, was due to Pinzon himself.

In 1508 Pinzon, in company with Juan de Solis, again ran over this same coast, or at least a part of it, but in the contrary direction. In the combined notes of the two voyages furnished to Peter Martyr de Anghiera and published by him in 1511 in the first edition of his Decades, a few Indian names appear, and amongst these, in the section here studied, those of 'Paricura'* and 'Camamóro' applied to the two margins of the Amazonas.

It is to be noted that Peter Martyr only employed the name 'Maranon' in his writings of 1516 after it had been pronounced by two of Lepe's companions in the Diego Columbus suit of 1513. Owing to the incomplete state of the Juan de la Cosa map, which has a large rent in the place where the gulf of Maranhão should appear, it is impossible to say whether this name originated with the expedition of Lepe, or

* Caetano da Silva ('L'Oyapoc et l'Amazone,' Vol. II., p. 381, in the Rio Branco edition) cites Baena as authority for the existence of a tribe of Indians with this name to the north of the mouth of the Amazonas. Being published in 1511 and in a work that was doubtless eagerly consulted by all cartographers, the name Paracura appeared at once in the maps and became characteristic for the Amazonian region; it seems strange that its companion Camamōro should not have had the same good fortune.

if it was only current among sailors, having originated with some other expedition (presumably Portuguese) of which no historical notice has been preserved. The almost constant practice of the old map-makers of employing the name with the article, or without any qualifying term (*O* Maranham, or simply Maranham or Maranon) is very suggestive of a topographical term, such as, for example, 'O Porto,' 'El Farallan,' etc. The Portuguese marine terminology has 'O Marachão,' which would be very applicable to this part of the coast full of shoals and bars, and, as already noted, this name might easily be transformed into 'Maranhão' amongst people of slight literary culture.

The above-mentioned hypothesis of another expedition seems the most plausible one. The letter of Estevão Froes* written from San Domingoes on the 30th of July of 1514 after a year's imprisonment subsequent to a voyage along this coast, mentions João Coelho, 'he of the gate of the cross, residente of the city of Lisbon,' and Diego Ribeiro as his predecessors in this navigation. The name 'João de Lisboa' which appears in the second group of maps above analyzed seems to commemorate the first of these navigators, and in this case it may be presumed that it was furnished by some member of the expedition that had remained in the vicinity of Maranhão, and that another member of the same, passing to Italy, may have furnished the information on which the relatively detailed and accurate representation of this vicinity in the Freducci map of 1514 (?) was based.

In the suit of 1513 the pilot Andreas de Morales declared that he had made a map of this coast based on the information of Pinzon and Lepe. It is probable that this map (or another organized in the same condition and preserved in the Casa de la Contratacion of Seville) served as a prototype for the Diego Ribeiro map of 1529, notwithstanding that this does not show evident signs of having proceeded directly from either of these first expeditions.

* Cited by Varnhagen and given in full by Capistrano de Abreu in the pamphlet entitled 'Descobrimento do Brazil e o seu desenvolvimento no seculo XVI.' published in Rio de Janeiro in 1883. The name 'Fernão' given in this pamphlet was corrected to 'Estevão' in the recent work by the same author published in the volume of the fourteenth centennial of Brazil.

In the same suit Pinzon identified his Cabo Santa Maria de la Consolacion with the Cape Santo Agostinho of the Portuguese navigators, but it is evident that here he either deceived himself, or sought to deceive others. It is possible that through another error of identification on the part of other witnesses of the same suit, the name 'Maranon' was applied to the Mar de Agua Dulce (or Amazonas) of Pinzon, since, judging from the Freducci and Maiollo maps, this name seems to have an origin independent of the expeditions of Pinzon and Lepe.

According to the terms of the above mentioned letter of Estevão Froes, his voyage was made in the year 1513 and in company with Francisco and Pero Corso, and at some point of the coast there was a hostile encounter with the Indians with whom was a certain Pero Galego (Pedrò de Galicia). The name 'Corso' given to a cape in the Maiollo map seems to indicate information obtained from some member of this expedition, and, this being the case, it may be presumed that the name 'Rio Pero' in the same map refers to the Pero Galego of the letter. On this hypothesis this person must have been located in the vicinity of the gulf of Maranhão, having probably been left there by some of the preceding expeditions.

Another Portuguese navigator skirting the coast some time before 1523 applied to it a great many new names which in some way came to the knowledge of an Italian cartographer, author of the so-called Turin

map. The fact is not referred to in the written history, and as the names remained limited to this map, which only became known within the last few years, this voyage did not constitute a notable permanent contribution to the knowledge of the geography of the region.

In 1527 an anonymous cartographer of the Casa de la Contratacion of Seville (probably Diego Ribeiro, author of the very similar map of 1529) organized a map in which the northeast coast was represented according to the data registered in that department, which, according to the express declaration of Diego Ribeiro in his map of 1529, was derived exclusively from the voyages of Pinzon and Lepe. In this map, as in that of 1529, the Amazonas is figured in a position that corresponds better with the southern mouth (or Rio Pará) than with the northern one, which is reduced to a simple bay with the name of 'Furna Grande,' although its proper position under the equator, as in the map of Juan de la Cosa, is preserved. To the great river thus dislocated to the southward was applied the name of 'Maranhom' in the 1527 map, and that of 'Maranon' in that of 1529, the first form being very suggestive of a Portuguese origin. In both these maps the gulf of Maranhão with its characteristic bifid inner-extremity is figured in its proper position with the name of 'Furna.'

In 1531, according to the investigations of Varnhagen ('Historia geral do Brazil,' 2d ed., I., p. 117) Diogo Leite, a Portuguese official, explored the coast between Pernambuco and the southern mouth of the Amazonas, and it is probable that to this explorer should be attributed the new type of map which, as we have already seen, appeared between the years of 1529 and 1534. Whoever may have been the author of this work, it is certain that between these dates an entirely new and very meritorious topographical survey of this part of the coast was made, and by a person who from previous maps took only the nomenclature of that of Maiollo, or of some other one very similar to it. It is equally certain that this explorer remained long enough in the vicinity of Maranhão to recognize and represent in a truly admirable manner its leading topographical features and to learn various indigenous denominations; or, which is more probable, a person was here met with who through long residence was able to furnish this information. The 'Pero Galego' mentioned by Estevão Froes, if still alive, would be in these conditions, and the hypothesis is not a very risky one that he was the informant. Whoever it may have been, somebody before 1534 furnished the cartographers* with elements for representing the hydrographic basin of Maranhão in a manner that presents a notable contrast with the grotesque representations of those of the River Plate and Amazonas based on the exploration of a Sebastian Cabot and of an Orellana.

The unfortunate attempt of Ayres da Cunha in 1536–38 to found a colony in Maranhão left no traces in the cartography of the region, unless the name 'Ascençao' in the maps of Diogo Homen and Desceliers is an interpolation in their prototype of a denomination given by this expedition. In the written history, however, the name given to the ephemeral settlement is 'Nazareth.'

About 1560 the cartographers commenced to attempt a representation of the interior of the continent, supplying the lack of definite data by flights of the imagination. Diego Gutierrez figured a great river uniting, across the continent, Lake Titicaca with the gulf of Maranhão and thus duplicating the

* Some of the maps made after this expedition differ somewhat in the drawing and in some of the names, from the earliest one preserved (that of Gaspar Viegas of 1534), and it is probable that there was another Portuguese prototype that has not come down to us.

Amazonas of Orellana; Bartholemeu Velho, in his map of 1464, represented a great central lake (Eupana) from which flowed to the south the Paraguay, to the north and entering the Amazonas the 'Paraa' (thus representing quite well the Tocantins), and to the east two rivers entering the São Francisco (quite well figured but united to the Paraná) which bifurcated to the coast of Maranh o by the river 'Abiunhao' (Parnahyba) and to that of Sergipe by the river 'Real.' This last feature persisted in maps until 1700.

The Gutierrez map, printed in Amsterdam in 1562, had an enormous recuperation and served as a prototype for a flood of maps characterized by a double Amazonas, published by the great Dutch printing firms of Ortelius, Mercator, etc. The equally bold conception of Bartholemeu Velho (reproduced, as regards the hydrography, by Vaz Dourado) had a somewhat more delayed entrance in current cartography, in which it was introduced in 1585 by Jan van Doet, whose map is essentially a reproduction of that of Bartholemeu Velho, of which the original only recently became known. These two types of maps, reproduced and modified *ad infinitum*, dominated cartography until 1625, when Jean de Laet, in the first edition of his great work on the New World, made a radical reform, introducing, on the basis of Portuguese marine charts and of Dutch explorations, the configuration which, improved but not essentially modified, has persisted till to-day. This last group of maps offers an interesting subject for study, for which, however, I have not the elements at hand. ORVILLE A. DERBY.

SÃO PAULO, BRAZIL,
June, 1903.

## SCIENTIFIC BOOKS.

### GOULD'S BIOGRAPHIC CLINICS.

MEDICAL teaching has always been essentially demonstrative; and in modern days the facilities for bedside or 'clinical' instruction have been enormously enlarged. No instructor, however, has ever before gathered so distinguished an array of 'subjects' as Dr. George M. Gould brings before his world-class to illustrate his lectures upon 'Eye-strain.'* For it is in the irritation of nerve centers as a result of the accommodational strain necessitated by the attempt to use faulty visual apparatus in work requiring delicate adjustment and continuous effort, that this eminent lexicographer and ophthalmologist finds the ready explanation of the physical miseries of the great students, artists and writers whose pathologic life-history he studies. Certain common factors are found in these histories, not the least important of which are the early development and long persistence of the symptoms, their recurrence whenever the sufferer used the eyes in work or study, their resistance to all sorts of treatment, their relief when enforced rest from work gave unwitting deliverance from their cause and, finally, in those who survived to that period of life, their sudden disappearance, when accommodational effort ceased to be possible. The 'mysteriousness' which the symptoms seemed to assume both to patients and to physicians, is also a point well worth noting. To quote Dr. Gould's own words: "This lack of cause or reason for their sufferings struck each one, and pages of excerpts might be gathered showing their wonder. An unseen malignant enemy or fatality seemed seated above them or at the very heart of their being, implacable and unexplainable. To their physicians they turned with beseeching question, and imploring aid. Some spent a great part of their lives in going from one doctor to another, or in testing quackery, in traveling for hoped relief anywhere, by

* 'Biographic Clinics: The Origin of the Ill Health of DeQuincey, Carlyle, Darwin, Huxley and Browning.' *Idem*, Volume II., George Eliot, George Henry Lewes, Wagner, Parkman, Jane Welch Carlyle, Spencer, Whittier, Margaret Fuller Ossoli and Nietzsche. By George M. Gould, M.D., Editor of *American Medicine*, Author of 'An Illustrated Dictionary of Medicine, Biology, etc.,' 'Borderland Studies,' 'The Meaning and Method of Life,' etc. Philadelphia, P. Blakiston's Son & Co., 1903, 1904.

'change of climate,' 'change of scene,' etc. Most of them tormented themselves all their lives in dieting, and two gave much of their life to the hydropathic delusion.* In every case the one fact stands out clearly, and it could be verified by any number of quotations, that their miseries were consequent directly and quickly upon use of their eyes in writing or reading, and yet not one of them, while repeatedly chronicling the fact with his own pen, ever caught a hint of the causal nexus."

Fully to appreciate the force of the evidence one must read the facts that Dr. Gould has patiently gathered not only from the narratives of biographers and relatives, but also from the letters and notes of the sufferers themselves. In Chapter I. of Volume II., which reproduces a paper upon 'Eye-strain and the Literary Life,' read before the Canadian Medical Association, the author summarizes and keenly analyzes the symptoms of these fourteen elect men and women. He points out the folly of attributing reflex symptoms to disease of the organ in which the distress happens to be manifested, thus treating the same person at different times for 'brain-fag,' for 'dyspepsia,' for 'neurasthenia,' or perhaps attributing the condition to 'pure cussedness.' He shows how, especially in the case of Nietzsche, a sensitive organism may be irritated almost to the point of madness by the continual torture following the attempt to use the eyes for work to which they are not adapted. The pity of it is that with suitable glasses—mark the word suitable—all this suffering might have been averted. Dr. Gould further shows that the chief and most poignant symptoms from which the subjects of his clinics suffered can, in at least ten of the cases, be reduced essentially to the symptom-complex now termed 'hemicrania' or 'migraine'—in ordinary language, 'sick headache.' Hence the frequent recurrence of gastric distress, distaste for food, nausea, vomiting, pain in the head—hence the frequent erroneous accusation of stomach, brain, nerves, liver—hence the frequent invocation of that indefinite scape-goat, 'biliousness.'

* Which is something far different from scientific hydrotherapy.—S. S. C.

The dependence of migraine upon eye-strain as an exciting cause in a large number, perhaps the largest number of cases can no longer be denied by the most doubting Thomas. The writer of this review placed himself upon record to that effect so long ago as 1892. It is true, however, and here we probably differ from Dr. Gould, that in order for the eye-strain reflex to take the form of this particular paroxysmal neurosis the individual must present that special type of organization in which the inhibition or, to use a broader term, the taxis, of the vaso-motor mechanism is deficient —a defect* usually inherited but sometimes acquired by unwise living or in sequel to some pathologic accident. Otherwise the persistently recurring disorder would be much more common than it is among those whose eyes present the very common faults of astigmatism and hyperopia, as likewise among myopes having high degrees of ametropia. Also, in individuals presenting vasomotor ataxia, other exciting causes, likewise, may provoke the attack of migraine, as of asthma, of hayfever, or of some other nerve-storm. Be this as it may, the relief of eye-strain, by guarding the powder from at least one of the sparks that threaten, prevents that particular explosion.

Dr. Gould's great merit lies not so much in his individual theory of the causation of migraine as in his directing strongly the attention of the medical profession and, it is to be hoped, of workers in literature and science who are not physicians, to the necessity for eyes and the relief of eye-strain by suitable glasses, with recorrection from time to time, as the refraction alters and the reflex disturbances recur; the other, and in some respects greater, being the importance of gathering all facts concerning the ill health of any individual into a comprehensive whole, rather than to consider detached fragments as things utterly apart. As the writer has elsewhere expressed the same thought, 'the spokes are

* From the physical standpoint a defect; but in my observation so frequently associated with marked artistic and intellectual ability, that I am not sure that in moderate degree it is less than an advantage to a writer, actor or public speaker. S. S. C.

many, but the hub is one.' This method applies indirectly even to pathologic accidents such as acute infections; but its direct bearing is of course upon what may be termed the basic condition of health or disorder.

Many ophthalmologists of high repute and many internists ('general physicians') of experience and authority concur in greater or less extent with the views that Dr. Gould puts forth, but others of equal standing, and among them many reviewers in the medical press, differ from him radically; and some have even sought to cast ridicule upon 'Biographic Clinics' and their author because of what are termed his 'extreme' assertions. Doubtless he is over-emphatic. He has an earnest and virile style and evidently feels deeply upon the subject he is treating. There can be no mistaking his earnestness or his meaning and there can be no doubt that he arraigns with some bitterness, not his brother practitioners, but the inertia or the blindness that has delayed their full acceptance of the great medical truth to which he calls attention and to the development of which Dyer, Weir Mitchell, Thomson and Norris, of Philadelphia, Martin, of Paris, and others, including Dr. Gould himself, have contributed importantly.

Nobody likes to be scolded in public, and Dr. Gould has not been wise in seeming to scold. Grant this, however, and the truth still remains true. Grant, moreover, that he is extreme in the statement of the truth—let us then forget the 'extremity' of the statement and remember the verity of the fact stated. Unquestionably it is a truth of vast significance. Unquestionably physicians have not yet fully realized that significance.

The great importance of the eyes in human life and work, or the complexity of the work demanded of the eyes by modern civilization, need not be dilated upon. Our early ancestors had greatest need of good distant vision, and their range was bounded only by the sky and by the horizon. We spend much of our time within narrow walls and beneath low ceilings; walls too narrow, ceilings too low, even in palaces. In addition, we read or write or sew or paint or do surgical operations or decipher cuneiform inscriptions or study palimpsests or set type or look through microscopes or work at machines of various kinds, demanding close sight and more or less constant accommodational effort. Few are born nowadays with natural optical apparatus perfectly adapted to the environment. Some are fortunate enough not to undertake just exactly those lines of endeavor that call for the greatest use or most delicate adjustment of the ocular mechanism. Moreover, in many cases a fair approximation to good refraction answers; a pair of glasses is obtained which more or less imperfectly corrects the error, and all goes well. There are many persons, however, in whom, whether from natural sensitiveness of temperament, from the complexity, obscurity or magnitude of the ocular defect, from the excessive amount of eye-work done, or from failure of general health rendering the whole organism more sensitive to peripheral irritation, neglect of the eye or happy-go-lucky correction will not serve. Eye-strain ensues; asthenopic reflexes of all kinds are set up and these may be as varied in kind or grouping as the number of organs in the body multiplied by the number of possible individual peculiarities, and then as the number of possible permutations among the figures thus obtained.

'Eye-strain,' it is to be added, does not mean exclusively, or even chiefly, strain of the external muscles of the eye. Muscular defects may or may not, as Dr. Gould contends, be dependent in every instance upon refractive error—that it is so in many instances must be admitted. In any event accommodational strain is the fact of greatest importance. Moreover, Dr. Gould asserts that astigmatism is, of refractive errors, the one causing greatest distress. This is borne out not only by the personal experience of the writer as a patient, but also by his observation as a physician and the reports of many oculists to whom he has referred patients presenting reflex symptoms. Nor can any, however small, amount of astigmatism safely be treated as the old French doctor is said to have advised his students to treat a cold in the head—'with contempt.' The smallest appreciable amount needs correction. Astigmatism imperfectly

corrected is astigmatism uncorrected; and it continues to excite reflexes—cerebral, muscular, cardiac, respiratory, digestional or whatnot.

We should not like to be misunderstood as teaching that eye-strain is *fons et origo mali* to all the ills that flesh inherits; or even in every case of nerve exhaustion, headache or dyspepsia in students and writers. Neurasthenia, gout, indigestion, can develop in those whose eyes are emmetropic, or, if ametropic, have been skilfully corrected. Too much confinement, too little exercise, injudicious diet and other errors of temperament, work and habit may cause many and varied symptoms, in the entire absence of eye-strain. Nevertheless, it is to be admitted that even in cases of other fundamental origin an uncorrected or imperfectly corrected refractive error will aggravate or even precipitate the symptoms.

We are not willing to go so far as Dr. Gould in ascribing, for example, the final break-down of Nietzsche to eye-strain alone. Of two 'extreme' and untenable hypotheses concerning that brilliant unfortunate we prefer Gould's to Moebius's, but we accept neither. We have no third to offer, for the facts before us are not sufficient to warrant dogmatism. Certain it is, however, that much of Nietzsche's misery was due to eye-strain. True, his eyes were examined and treated, but in all probability there remained undiscovered or uncorrected some worrisome refractive error —for the Germans have yet much to learn of the art that owes so much to the science of great Germans. An odd or complicated astigmatism, possibly of low amount, may have eluded detection or there may have been failure to adjust properly glasses correctly prescribed, or the personal equation of the patient may not have been met skilfully—there are numerous possibilities; and one guess is as good or bad as another.

To sum up: Dr. Gould has conceived with the brain of a master thinker and inscribed with the pen of a ready writer two volumes of 'extreme' readability, interest and importance; on the whole wise in tone, always forceful, usually graceful, often elevated in diction; unfortunately marred now and again by useless acridity or unnecessary denunciation. He has shown that much, if not all, of the constant or recurring distress of a number of the leading spirits of the nineteenth century—distress otherwise mysterious and unaccountable —was in all probability due to refractive defects of the eyes and the consequent accommodational strain made necessary during work. It might, therefore, have been relieved in large part, if not entirely, by suitable glasses; and this is the great, but therefore simple, lesson for physician and for patient. In emphasizing this lesson the author has emphasized old and unappreciated truth; he has also added to the sum of truth. It is a work well worth the doing; a work certainly not inferior to the invention of a new staining fluid, the synthesis of a new hypnotic drug or the description of a new symptom-complex; a work, of which the true value will become more apparent as the years increase.

SOLOMON SOLIS COHEN.

## SCIENTIFIC JOURNALS AND ARTICLES.

THE April number of the *Botanical Gazette* contains the following articles: Mary Ellen Bennett, under the title 'Are Roots Aerotropic'? has shown that the claim of Molisch can not be sustained by her numerous experiments. She also offers a solution for the curvatures of roots recorded by him and termed aerotropic. Aven Nelson in his fifth 'Contributions from the Rocky Mountain Herbarium' describes a large number of new species, chiefly from southern Utah and southern Nevada. Florence Lyon discusses 'The Evolution of the Sex Organs of Plants,' upon the basis of numerous very interesting cases of exceptional development of antheridia and archegonia that she has found, chiefly among Pteridophytes. Charles Robertson makes a suggestive contribution to the phylogeny of Angiosperms from the standpoint of his study of the problems of pollination. His contention is that the primitive Angiosperms were entomophilous, and that the anemophilous ones are metamorphosed entomophilous flowers, whose seemingly simple structures are degraded, not primitive. F. V. Coville dis-

cusses and figures 'Arcterica, the Rarest Genus of Heathers,' living on Bering Island. W. F. Ganong has begun a series of descriptions of 'New Precision-appliances for Use in Plant Physiology,' this first paper dealing with a clinostat and a portable clamp stand.

## *SOCIETIES AND ACADEMIES.*

### THE NATIONAL ACADEMY OF SCIENCES.

The following papers were presented at the spring session held at Washington on April 19, 20 and 21.

E. L. Nichols and Ernest Merritt: 'On Fluorescence Spectra.'

John Trowbridge: 'Spectra of Gas at High Temperatures.'

Theodore Lyman, presented by John Trowbridge: 'Short Wave-Lengths of Light.'

H. W. Morse, presented by John Trowbridge: 'Spectra produced by the Wehnelt Interrupter.'

George F. Barker: 'Note on Radioactivity and Autoluminescence.'

R. S. Woodward: 'A Double Suspension Apparatus for determining the Acceleration of Gravity.'

R. S. Woodward: 'The Compressibility of the Earth's Mass required by the Laplacian Law of Density Distribution.'

Henry L. Abbot: 'The Disposition of Rainfall in the Basin of the Chagres.'

A. F. Zahm, introduced by A. Graham Bell: 'Surface Friction of the Air at Speeds below 40 Feet a Second.'

R. H. Chittenden: 'Physiological Economy in Nutrition, with Special Reference to the Minimal Proteid Requirement of the Healthy Man.' A preliminary Report.

Henry F. Osborn: 'Recent Paleontological Discoveries by the American Museum Exploring Parties.'

Henry F. Osborn: 'Reclassification of the Reptilia.'

W. D. Matthew, submitted by Henry F. Osborn: 'Position of the Limbs in the Sauropoda.'

Horatio C. Wood, Jr., presented by Horatio C. Wood: 'A Preliminary Report upon *Apocynum cannabinum.*'

Arthur T. Hadley, presented by the Home Secretary: 'Biographical Memoir of James Hadley.'

Charles L. Jackson: 'Biographical Memoir of Henry Barker Hill.'

Alexander Graham Bell: 'The Multi-nippled Sheep of Beinn Bhreagh.'

Simon Newcomb: 'Application of New Statistical Methods to the Question of the Causes Influencing Sex.'

C. S. Peirce: 'Note on the Simplest Possible Branch of Mathematics.'

### THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION.

The seventh meeting of the season was held April 8, at the Chemists' Club, 108 West Fifty-fifth Street. The following program was presented:

*The Determination of Manganese as Sulphide and the Composition of the Pink and Green Sulphides:* J. C. Olsen.

Professor Olsen discussed the advantages of separating and determining manganese as sulphide. The method is only practicable, however, when the sulphide is obtained as the green modification which is larger grained than the ordinary pink sulphide and, therefore, settles more readily and is more easily filtered and washed. This is best accomplished by pouring the manganese solution into a boiling solution of ammonium chloride and ammonium sulphide.

On analysis the pink sulphide showed variable amounts of water. This was found to be due to the fact that it is a mixture of a gray sulphide which holds more than three per cent. of water and a red sulphide. This modification was obtained pure and was found to hold the same amount of water as the green sulphide, about three fourths per cent. The difference between the pink and green sulphide is held to be one of molecular structure, rather than of chemical composition or degree of hydration.

*On the Combination of a Solvent with the Ions* (preliminary paper): J. Livingston R. Morgan and C. W. Kanolt.

Preliminary experiments were reported which show that by electrolyzing a solution of silver nitrate and pyridine in water, pyridine migrates with the silver and increases in concentration at the cathode, while it decreases at the anode. With cupric nitrate and water, dissolved in alcohol, water migrates with the copper ions and increases on the cathode and decreases at the cathode.

This indicates the presence in solution of combinations of the ions with the solvent to form complex ions, which break up at the electrodes. The results show only the difference in the amount of solvent carried by the two ions. The application of the law of mass action to one such equilibrium shows that by it van't Hoff's form of Rudolphi's empirical dilution law can be readily derived. Thus, if $MA$ is the salt and $S$ the solvent, we have

$$2MA + (X + 2y + Z)S = (\overset{+}{M}_2 \cdot \overset{+}{X}S) + 2(A \cdot \overline{YS}) + 2S,$$

and if $C_S$ is the undissociated concentration and $C_i$ that of one of the ions and $z$ large compared to $x$ and $y$, it follows that

$$C_i \frac{(2C_i)^2}{C_S^2} = 4\frac{C_i^3}{C_S^2} = \text{constant},$$

The authors call attention to the fact that in this way it is easy to account for the variation in the speed of migration of the ions with the dilution, the presence of solvent of crystallization and the variation in the value of $n$ in the general empirical dilution law $C_i^n/C^S =$ constant. It was observed that this takes nothing away from the theory of ionization, but, in fact, conditions only those portions of the theory which have hitherto failed to hold.

*Thorium, Carolinium, Berzelium:* CHARLES BASKERVILLE.

Professor Baskerville reviewed the history of thorium, and especially the recent work bearing upon the question of its complexity. The study of radioactivity of thorium preparations led to the conclusion that thorium itself is not primarily radioactive and that the radioactive substances existing in thorium as ordinarily prepared are far too small in quantity to influence the atomic weight values as reported. Discrepancies in atomic weight determinations led to the fractionation of thorium by means of phenylhydrazine. The investigation of the fractions thus obtained and of the so-called 'volatile thorium' has given evidence of the two new elements, carolinium and berzelium, which differ markedly from thorium in the densities and solubilities of the oxides and in the results of atomic weight determinations by the sulphate method. The purified thorium shows phosphorescence with ultraviolet light, while carolinium and berzelium do not.

*Exhibition and Demonstration with Radium of 1,800,000 Activity and Actinium of 10,000 Activity and their Action upon Minerals and Gems:* G. F. KUNZ.

Dr. Kunz showed a number of photographic prints made from specimens of pitchblende now in the possesion of the Imperial Museum of Vienna, and added to that collection in the years 1806, 1807, 1814 and 1853. There seemed to be no difference in the intensity of the radioactivity of the specimens recently found (within a year or two in the mines) and those that are fully one hundred years old. Another photograph shown was made in eight seconds by laying a diamond upon a photographic plate and holding a specimen of radium (300,000 activity) on the back. Actinium chloride made by Dr. Debeirne and radium bromide from the Curie laboratories, were exhibited and their effects upon diamond, kunzite and willemite were shown experimentally, as well as a number of illustrations of the penetrating power of the radium rays.

H. C. SHERMAN,
*Secretary.*

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 358th meeting was held March 22. The election of Lieutenant William E. W. MacKinlay, U. S. A., was announced. The secretary read the notice of the 14th International Congress of Americanists which will be held at Stuttgart, August 18–24, 1904.

Professor Holmes gave an account of the successful archeological work in the West Indies in which Dr. J. Walter Fewkes is engaged this winter.

Dr. I. M. Casanowicz read a paper entitled 'The Scarab.' He gave a description of the beetle and spoke of the ideas of the ancients concerning the habits of this peculiar insect. The earliest scarabs are those of King Nebka, 3,000 B. C. They were in use for 3,000 years, and show the earliest sculpture and evidences of art. The scarab is essentially an Egyptian

gem as the cylinder is Assyrian. Among the funeral scarabs especially to be mentioned were those placed upon the heart of the dead; these were usually inscribed with passages from the book of the dead; they were worn by the living as ornaments and amulets, and the historical scarabs, as those of Amenophis, were of large size and covered with inscriptions recording royal deeds. The paper was discussed by Dr. Weston Flint.

'The Franco-Egyptian Medal,' was the title of a paper by Col. Paul E. Beckwith, of the Division of History in the National Museum. Col. Beckwith briefly described the Napoleonic expedition to the valley of the Nile and spoke of Champollion and other French men of science who gave undying luster to this otherwise disastrous campaign. Col. Beckwith gave a history of the issuing of a medal by Louis XVIII. commemorative of the Egyptian explorations and described figures of Egyptian divinities which appear on this remarkable work of art.

Professor W. H. Holmes read an illustrated paper on 'Significant Analogies between Pre-Columbian and Oriental Art.' Professor Holmes discussed the subject of the peopling of America from the east and placed on the screen a series of portraits of various peoples from India, Mexico and around the Pacific. The views showed a remarkable similarity of types between the continents as to external features. Professor Holmes spoke briefly on the latitudinal modifications of peoples. A series of views showing types of architecture and art following the same range were next shown. Professor Holmes pointed out the use of pyramids in both hemispheres and the efflorescence of decorative designs to cover surfaces, these designs both in Cambodia and Mexico arising from religion. There is, said Professor Holmes, sufficient reason for studying the problem of art in southeastern Asia, and in the light of our present knowledge one is led to feel that there may have been oversea contact between America and Asia at the period of the great Buddhist revival about 1,000–2,000 years ago.

In the discussion Dr. Casanowicz said that there is unity in the multiplicity of anthropological phenomena. Buddhist art at the time of Asoka was affected by Persian art which was itself influenced by Assyro-Babylonian culture, and these facts explain the transplanting and derivation of architectural and art forms. By establishing a connection between Hindu and aboriginal American art an unbroken chain, as it were, is formed.

Col. Flint spoke of the similarity of the dragons of Chinese mythology to those of Central America. Miss Alice Fletcher said that there is unity of race and of art culture based on psychical conditions, hence the continents touch.

Dr. Hrdlicka agreed with Professor Holmes as to the Asiatic influx to America, and, discarding language as a factor, said that somatologically there are many points of agreement between the entire Malay-Mongolian stock and the American aborigines. The main difficulty in identifying the Americans with the Malay-Asiatics was the old error of making from the Indian a 'red' race.

Walter Hough,
*General Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON.

The 385th regular meeting was held Saturday evening, April 2, 1904. Henry Oldys spoke on 'The Use of Our Musical Scale by Birds.' He briefly sketched the history of music, and then analyzed examples of bird music, showing that, judged by modern standards, they take higher rank than such specimens of the music of ancient Greece and the early church as have been preserved. The evolution of the modern diatonic scale among various peoples, some of whom must have developed it independently—Egyptians, Chinese, East Indians, Papuans, Bushmen, Aztecs, Iroquois Indians, Bellacoola Indians (British Columbia), Greenland Eskimos, and many others—indicates that there is something in this particular combination of definite and mathematically related intervals that is peculiarly satisfying to the musical taste, a taste shared by man only with birds. As some birds exhibit other essentials of modern music—rhythm, melodiousness, symmetry, etc. —we should naturally expect them to use the

modern scale, another essential, and, therefore, the burden of proof is upon those that deny its use by them. Two instances were cited in which the same notes were taken down on separate occasions, in each of which the record was completely independent and the first was not in mind when the second was taken. A phonographic record of an Eskimo song secured on one of Lieutenant Peary's expeditions was presented to demonstrate the identity of the intervals used by the singer with those of the modern scale. In conclusion, a whistled imitation was given of a melodious and rhythmical song of a wood pewee, and it was remarked that the technical requirements of modern music observed in the construction of this song are far more wonderful than the use it makes of the intervals of the modern scale.

Wilfred H. Osgood spoke on 'The Caribou of Alaska,' giving an outline of the present state of knowledge of the subject and detailing his own experience with one of the still remaining herds. The caribou of Alaska are all of the barren-ground type and their specific or subspecific relationships are still very imperfectly understood. They are found in comparatively large numbers in three general areas—the Alaska Peninsula, the region between the Yukon and Tanana rivers, and northeastern Alaska between the Yukon River and the Arctic coast. They have been exterminated over a large part of their former range and are now being killed in large numbers for their flesh and hides. Their annual increase, however, is large and they might easily be preserved under very liberal shooting regulations provided these could be enforced. A number of small scattering herds were observed in the region between the Yukon and Tanana rivers near the town of Eagle. The habits of the animals and the methods of hunting them were described. Lantern slide views showing small herds of the animals and the character of the country inhabited by them were shown.

M. W. Lyon, Jr., read a paper presenting the results of a study of the existing hares, rabbits and pikas, based on skulls and skeletons mainly in the collection of the U. S. National Museum. The hares and rabbits, family Leporidæ, were shown to contain ten distinct genera, many of which have previously been recognized as subgenera. Two were pointed out as new. The pikas, family Ochotonidæ, were shown to contain a single genus, *Ochotona*, composed of three subgenera. The characters by which the groups are determined are found in the enamel pattern of the teeth, the form of the cervical and lumbar vertebræ, sterna, ribs, bones of the forearm, etc., in addition to characters of the skull. Regret was expressed that only very few skeletons were available for study and the desirability of securing at least one skeleton of each species of mammal in addition to numerous skins and skulls was emphasized.

M. C. Marsh read a paper on 'The Gas Disease in Fishes.' The subject was first investigated at the Bureau of Fisheries' station at Woods Holl, Mass. The sea water for the aquaria was forced by steam pumps into elevated tanks for a gravity flow. Leaks in the suction pipe allowed air to enter, which, upon passing through the pump, was forced into solution by the hydrostatic pressure. The water reaching the aquaria was supersaturated with atmosperic nitrogen, possibly also with oxygen. In this condition it was rapidly fatal to all adult fishes, death usually being due to gas embolism. The occurrence of the free gas in the blood vessels was explained as a precipitation due to the slight elevation of the temperature in the systemic circulation, the blood as it passed through the gills tending to supersaturate like the water. A hydrostatic pressure of about six pounds prevented all symptoms of the disease, presumably by raising the saturation point of the blood plasma. The water could also be rendered harmless by a deaerating process as by passing it through perforated pans and allowing it to fall through several feet in a shower of slender streams. The renewal of the suction pipe, preventing access of free air to the water under pressure, likewise did away with all manifestations of the disease.

Wilfred H. Osgood,
*Secretary.*

## DISCUSSION AND CORRESPONDENCE.

### THE TITLES OF PAPERS.

The writer is quite at one with Professor H. H. Wilder in his interesting protest, which appeared in Science, March 18. No doubt all in their younger days have indulged in the same pleasure of lengthy titles. Masters in rejuvenated science did the same; *vide* Humphry Davy's papers at the beginning of the nineteenth century. Descriptive titles appear to have good reason for their use. Mere verbiage is objectionable in the presentation of any scientific fact or principle, be it in the title or in the body of the paper. Excusing limitative prolix titles, not strictly descriptive, on the plea of modesty, will not answer, as the writers of papers realize as well as the readers that no science is complete.

Perhaps my experience is not very different from that of others. Scientific literature probably keeps pace in the rate of production with modern novels. One neither cares nor is able to read all, but he would like to know what is going on. Some forty or fifty scientific journals are placed on my desk every thirty days. All deal more or less with that division of science, chemistry, to which I have the honor and pleasure of devoting my humble labors. Even a specialist in the narrowest sense can do better work if he know something of other fields of activity. The undersigned finds it literally impossible to read all the articles in his own branch, much less labor through those of cognate subjects; consequently he must depend upon the title or the attached author's name in order to make a wise selection. An exceedingly interesting and valuable paper is published by an author whom the reader happens not to know, the title does not tell enough, the article is long, life is short and one passes it by. Numerous other causes preventing the reading of papers come to mind, but do not require enumeration.

Those journals which consist solely of abstracts, not opinionated reviews, come near offering a solution to the problem. This brings out another tale of woe. Numerous complaints have been made of the failure on the part of abstractors, however conscientious they may have been, to give really what the author meant to emphasize. Therefore, the suggestion is pertinent that we have distinctive titles followed immediately by a condensed *'synopsis' made by the author.*

I am quite well aware that many papers in some journals have a *'conclusion,'* which one must hunt for, and such an arrangement is in accord with strict logic; but below is an explanatory paragraph the writer recently placed at the beginning of a series of some two dozen papers on work in a narrow field.

> We shall adopt in reporting investigations upon the rare earths the plan of succinctly stating in an introductory paragraph the facts observed and conclusions arrived at. Those desirous of familiarizing themselves with the details may peruse what follows at leisure. Perhaps others may care to pursue a similar course. No doubt a wider dissemination of the actual results arrived at will come about and the labors of abstractors be lessened and more accurate. Expediency influenced literary style before the twentieth century.

The writer believes such practice will accomplish the objects aimed at by Mr. Wilder and himself, and is independent enough to continue it alone, unless the various editors are too strenuous in their objections.

Chas. Baskerville.

University of North Carolina,
March 22, 1904.

To the Editor of Science: It is curious that Mr. H. H. Wilder's article (Science, March 18, 1904) should follow immediately on Mr. F. H. Knowlton's protest against a particular solecism. The two represent different sides of the same subject. Theoretically we must all support Mr. Wilder's plea for brevity, and the broad principle governing Mr. Knowlton's warning against ambiguity should also find general acceptance. These two principles are combined in recommendation (4) of the British Association Committee on Zoological Bibliography and Publication, namely, 'that it is desirable to express the subject of one's paper in its title, while keeping the title as concise as possible.' The difficulty, of course, is to be both precise and concise.

*Brevity.*—Mr. Wilder's longest example contains only thirty-seven words, and is excused

by its date (1665) and by the fact that all except the first word really constitutes a subtitle. The British Association committee alludes to a title of recent date containing ninety-one words. Mr. Wilder's precepts are admirable, but the heading of this letter shows how even his example may be bettered. A certain leading society persists in prefixing the useless 'on,' and forces an author to entitle his paper 'On the Tears of the Crocodile' instead of 'Crocodile's Tears.'

*Clearness.*—Modesty, Mr. Wilder would suggest, made an author say, 'Some Contributions to our Knowledge of the Morphology of the Guyascutidæ,' instead of 'Guyascutid Morphology,' and that same modesty, presumably, forbade him to suppose that the casual biologist might not know what a guyascutid was, and made him keep to himself the precise nature of his contributions. The enormous number of generic names and their synonyms often makes it impossible for a reader to tell the subject of a paper from its title. A specialist on echinoderms turned out at night to hear a paper 'On the Structure of *Apiocystis*,' only to find that it was an alga (if my memory serves) and not the Silurian fossil of that name. When a paper was published on the fluid of the body cavity in a certain animal the whole staff of the largest natural-history museum was unable to say what kind of animal was meant. In such cases the explanatory word may lengthen the title, but it is fully worth the space. Mr. Knowlton's examples of ambiguity are not so bad as these, but bad enough. Even the best of them is not really free from doubt; for example, what would an American botanist understand by 'The Flora of the Coal Measures. An Ecological Study'? This reminds me that a geological bibliographer innocently placed in his slip-catalogue the title of a work on 'Anthracite Coal Communities.' He has since learned that this too is an 'Ecological' study, neither geological, nor paleontological, nor zoological, nor botanical.

In fine, let the man of words, whether modest or 'intoxicated with the exuberance of his own verbosity,' remember that 'Brevity is the soul of wit,' and let the epigrammatist make for himself no occasion to say, 'Brevis esse laboro, obscurus fio.'

F. A. B.

### MARGINAL AND RIDGE SCALES IN CEPHALASPIS AND DREPANASPIS.

In two or three of his recent articles on *Tremataspis*, Dr. William Patten has affirmed his belief, contrary to that of all other writers, in the existence of 'numerous pairs of jointed oar-like appendages' in certain fossil ostracophores. His latest paper, in the December number of the *American Naturalist*,* is noteworthy for its development of the thesis previously advanced by him to the effect that *Cephalaspis* is provided with a 'fringe of jointed and movable appendages (25–30 pairs) along the ventral margin of the trunk.'

Happily, the author does not postulate the existence of imaginary organs, as was done in the case of *Tremataspis;* but this time actual, definite structures are pointed out, familiar to every one as marginal scales, and these receive the new name of 'fringing processes,' and are interpreted as appendages. Regarding these structures Dr. Patten states that 'there is little doubt that they are the antecedents of the lateral fold of vertebrates,' although in another paragraph it is remarked that 'whatever their significance may be, there is apparently nothing known in true fishes that is exactly comparable with them.'

The present writer can not agree with his esteemed friend that these marginal scales, as they are commonly called, are not precisely what their name implies, and fails to see anything remarkable about them, either in form, in attachment or in position. Dr. Patten is quite right in observing that they are marked with the same surface ornamentation as trunk scales, nor do they differ from the latter in any other respect except that their extremities are free. The identical structures, if occurring in the median line above or below, would be pronounced *ridge scales;* if along the fin margins, they would pass for *fulcra;* if along the angles of modern flat-bottomed fishes, for *marginal* or *lateral scutes.* It may be, in fact, regarded as a general

* 'On the Structure of the Pteraspidæ and Cephalaspidæ,' pp. 827–865.

tendency amongst both vertebrates and invertebrates with a flattened ventral surface to have the lateral or pleural margins produced into processes of some sort. *Cephalaspis* is but one of numerous instances that might be mentioned amongst fishes, and illustrations abound amongst trilobites and various lower invertebrates.

The paired condition of the marginal scales in *Cephalaspis* is without significance, being a necessary accompaniment of the flattened ventral surface. Were the body laterally compressed, we should probably find but a single row of median scutes, as in *Lasanius* and *Birkenia,* although even in the latter genus Dr. Traquair is of the opinion that they are paired. Fulcra, also, are often paired; and it must be remembered that even a typically unpaired structure like the anal fin may occasionally appear as double. That the structures called 'fringing processes' by Dr. Patten can be looked upon in the nature of appendages has been emphatically denied by Dr. Gaskell,* who has studied the actual specimens upon which our Dartmouth friend bases his conclusions. Jaekel, of Berlin, likewise fails to see that there is any evidence of appendages in these forms.† Hence it would appear that paleontologists are not unanimously in favor of deriving the lateral fold of vertebrates from marginal scales such as occur in *Cephalaspis.*

*Drepanaspis.*—For our knowledge of the organization of *Drepanaspis,* one of the most interesting Paleozic fishes brought to light within recent years, we are indebted almost exclusively to the dean of British paleichthyologists, Dr. R. H. Traquair. In an appreciative review of Traquair's recent memoir on the 'Lower Devonian Fishes of Gemünden,' published in no. 471 of this journal,‡ Dr. Bashford Dean takes issue with the original author regarding the orientation of the creature. It is stated by Dean that Traquair's reasons 'seem inadequate for distinguishing dorsal and ventral sides. In no specimen figured is the relation of the dorsal lobe of the tail shown convincingly to be continuous with the so-called dorsal aspect.'

Whatever may be thought of Traquair's figures, although his plate 2 seems to us conclusive enough, there can be no question about the originals, and those who have examined them attentively are compelled to admit the correctness of the Scottish author's interpretations. The dorsal ridge scales are larger than the ventral, and form a more extended series, beginning further forward and continuing further back than the ventral fulcra. Several specimens in the Edinburgh Museum have been pointed out to the present writer by Dr. Traquair in which this row of prominent ridge scales can be traced continuously from a point shortly behind the median dorsal plate to the tip of the dorsal lobe of the tail. The extent to which the caudal lobes are covered with fulcra is well shown in Pl. 4 and Pl. 1, Fig. 1, of the memoir in question, and their connection with upper and lower systems of body plates appears tolerably distinct.

C. R. Eastman.

Cambridge, Mass.

* *Journn. Anat. and Phys.*, Vol. 37, p. 198, 1903.

† *Zeitschr. deutsch. geol. Ges.*, Vol. 55, p. 84, 1903.

‡ Science, Vol. 19, p. 64, 1904.

## *SPECIAL ARTICLES.*

### ON THE FEASIBILITY OF MEASURING TIDES AND CURRENTS AT SEA.

The importance of measuring the rise and fall of the tide, and especially the direction and velocity of the current at points more or less remote from land, is obvious to any one. The following brief discussion of a few questions involved seems to show that such measurements, although rather costly, can probably be made in almost any body of water whose surface at times becomes reasonably calm; at any rate, it should generally be possible to measure the current.

It is here proposed to make use of a species of piano-wire sounding apparatus, in which the 'lead' consists of a large stone, or of a bag or box containing stones, which is attached to the sounding wire by means of a string or a finer wire. This weight when once cast is to remain immovable on the bottom and is not to be recovered. The wire drawn taut serves to indicate when the vessel

passes over the weight. The aim of the observers on board is to so manœuvre the boat that the wire shall become apparently vertical as many times as possible throughout the period of observation, and at each such time to note the depth of the water and positions of the floats. For small depths, verticality can be estimated sufficiently well by aid of a plumb line held alongside of the sounding wire. For greater depths, more accurate means must be provided, such, for instance, as a small telescope supplied with vertical sight wires and hung in gimbals, together with a mirror placed alongside of the sounding wire and likewise hung in gimbals. If a boat were to be used exclusively for such work, it should have, at the point of least motion, a well through which sounding operations could be carried on. Of course, means must be provided for securing nearly uniform tension at the time of taking a reading. In small depths the approximation to uniformity need not be very close.

*Problem 1.*—Ignoring the impulse of the current upon the wire, also the sagging due to the wire's weight, required the amount of error in height or depth and in position due to the want of verticality of the wire.

Obviously,

$$\text{Height error} = l - l \cos \phi_s = l \text{ versed sine } \phi_s,$$
$$\text{Position error} = l \sin \phi_s,$$

where $l$ denotes the length of wire extending from the bottom to the surface, and $\varphi_s$, the small angle which it makes with the vertical at the time of reading. Giving to $\varphi_s$ several values, we have

| $\phi_s =$ | ¼° | ½° | 1° |
|---|---|---|---|
| Height error | =0.000010 | 0.000038 | 0.000152 |
| Position error | =0.004363 | 0.008726 | 0.017452 |

| $\phi_s =$ | 2° | 5° |
|---|---|---|
| Height error | =0.000609 | 0.003805 |
| Position error | =0.034900 | 0.087156 |

In depths not exceeding 100 fathoms, an error of 1 degree in verticality can not cause an error of more than 0.1 foot in height or depth.

*Problem 2.*—Ignoring the impulse of the current upon the wire, and supposing the (vertical component of the) tension at its upper end to be $\nu$ times as great as its weight in water, required the error in height or depth and in position when the wire is not exactly vertical.

Let $\varphi_s$ denote the want of verticality at the surface and $\varphi_b$ that at the bottom; then

$$\text{True depth} = a\ (\operatorname{cosec} \phi_s - \operatorname{cosec} \phi_b)$$

where

$$\cot \phi_b = \frac{\nu - 1}{\nu} \cot \phi_s$$

and

$$a = \nu l \tan \phi_s.$$

$$\text{Height error} = l - \text{true depth},$$
$$\text{Position error} = a\ [\log (\operatorname{cosec} \phi_s + \cot \phi_s) - \log (\operatorname{cosec} \phi_b + \cot \phi_b)].$$

If the wire is nearly vertical, we have the following approximate equations:

$$\text{True depth} = a \left( \frac{1}{\nu} \cot \phi_s - \frac{1}{2(\nu - 1)} \varphi_s \right),$$
$$a = \nu l\ (\phi_s + \tfrac{1}{3}\phi_s^3),$$
$$\text{Position error} = a \log \frac{\nu}{\nu - 1} + \frac{a}{4} \left[ 1 - \left( \frac{\nu}{\nu - 1} \right) \right]_2 \phi_s^2.$$

By aid of these equations doubtful interpolations can be avoided.

Assuming $\nu = 5$ and an apparent depth ($l$) of 3,000 units, we have as errors corresponding to a few values of $\varphi_s$:

| $\phi_s =$ | ¼° | ½° | 1° |
|---|---|---|---|
| Height error | = 0.035 | 0.143 | 0.571 |
| Position error | = 14.60 | 29.21 | 58.41 |

This shows that in a depth as great as 3,000 fathoms the upper end of the sounding wire should not deviate more than one half degree from the vertical if a tide of ordinary amplitude is to be determined.

*Problem 3.*—Ignoring the sag due to the wire's weight and assuming that the horizontal impulse of the current is the same for each vertical unit, required the error in height or depth and in position when the upper end of the wire is exactly vertical.

The wire forms the arc of a parabola with vertex at the surface and whose equation is

$$x = \frac{\mu y^2}{2T_s}.$$

This gives

$$\text{Position error} = \frac{\mu (\text{depth})^2}{2T_s} = \frac{\mu l}{2\nu w}$$

where $\mu$ denotes the impulse per unit length,

$w$ the weight in water of a unit length of the wire, and $T_s$ the tension at the upper end, $=\nu lw$; it is assumed that the wire is nearly vertical throughout its length. From rectifying the parabola, we obtain

$$\text{Height error} = \tfrac{1}{6}\frac{\mu^2}{T_s^2}l^3 = \tfrac{1}{6}\frac{\mu^2}{\nu^2 w^2}l.$$

Assume $\mu = 0.001$ lb., $\nu = 5$, $w = 0.003$ lb.; the position error will be $l/30$ and the height error $l/1350$. As will be noted below, $\mu = 0.001$ lb. and $w = 0.003$ lb., imply, for a steel wire, a velocity of about 0.6 foot per second. For smaller velocities $\mu/w$ will be much less. In deep water, with $\nu = 5$, we should not expect to generally find velocities such that the error in height due to the tidal current could exceed one part in 100,000, unless the law of resistance given below does not hold good for feeble currents. See velocities given near the end of this paper.

*Problem 4*.—Taking into account the weight of the wire and assuming that the horizontal impulse of the current is the same for each vertical unit, required the error in height or depth and in position when the upper end of the wire is exactly vertical.

The forces acting upon a length $l$ extending downward from the surface, give

$$\frac{dx}{dy} = \frac{\mu}{T_s - wl}.$$

From this we obtain, to the third power of the small quantities $\mu y/T_s$, $wy/T_s$,

$$x = \frac{\mu}{T_s}\frac{y^2}{2} + \frac{w\mu}{T_s^2}\frac{y^3}{3} + \frac{w^2\mu}{T_s^3}\frac{y^4}{4},$$

as the equation of the curve, the origin being the point where the wire crosses the surface. This rectified gives

$$l = y + \frac{\mu^2}{T_s^2}\frac{y^3}{6} + \frac{wu^2}{T_s^3}\frac{y^4}{4}.$$

$$\therefore \text{Position error} = \frac{\mu l^2}{T_s}\left[\tfrac{1}{2} + \tfrac{1}{3}\frac{wl}{T_s} + \tfrac{1}{4}\frac{w^2\mu l^2}{T_s^2} - \tfrac{1}{6}\frac{\mu^2 l^2}{T_s^2}\right],$$

$$\text{Height error} = \tfrac{1}{6}\frac{\mu^2}{T_s^2}l^3 + \tfrac{1}{4}\frac{w\mu^2}{T_s^3}l^4.$$

I have made numerous experiments for determining the force of the impulse of water upon slender cylindrical rods. The rods used were of steel and varied in diameter from 0.036 to 0.5 of an inch. The velocity ranged from 1 to $1\frac{1}{2}$ feet per second. The experiments showed that the force is well represented by the expression

$$\zeta\frac{v^2}{2g}\gamma ld,$$

where $v$ denotes the velocity of the water; $\gamma$, the weight of a cubic unit of water at the temperature of the stream; $l$, the length of the rod; $d$, the diameter; and $\zeta$ an empirical abstract number found to be 0.95, approximately, or about one half of the value (1.86) obtained from the experiments of du Buat and Thibault for the case of a plane perpendicular to the flow of the stream. In all cases where length is involved in the above expression, the same unit of length must be employed.

For sea water $\gamma$ may be taken as 64 lbs., and the above expression gives as the force for each foot of rod or wire

$$0.995\,\zeta v^2 d = 0.945\, v^2 d$$

pounds, $=\mu$.

In a steel wire suppose $d = 0.003$ foot; the force of impulse per foot $(=\mu)$ is

$$0.945\, v^2 d = 0.002835\, v^2,$$

while the weight per foot for wire immersed in sea water is 0.003 lb. $(=w)$. Hence, for a wire of this diameter the force of the impulse of the water will equal the weight of the wire in water (*i. e.*, $\mu$ will be equal to $w$) when the velocity is a trifle more than 1 foot per second.

For a simple progressive long wave of amplitude $A$ in a body of water whose depth is $h$, the maximum velocity of the water particles is

$$A\sqrt{\frac{g}{h}}.$$

Let $A = 1$ foot; then the velocities, expressed in feet per second, corresponding to various depths, are as folows:

| | | | | | |
|---|---|---|---|---|---|
| Depth = | 5 | 10 | 25 | 50 | 100 fathoms, |
| | 30 | 60 | 150 | 300 | 600 feet. |
| Velocity = | 1.035 | 0.732 | 0.463 | 0.327 | 0.232 feet. |
| Depth = | 500 | 1000 | 2000 | 3000 | 4000 fathoms, |
| | 3000 | 6000 | 12000 | 18000 | 24000 feet. |
| Velocity = | 0.104 | 0.073 | 0.052 | 0.042 | 0.037 feet. |

In deep water the meteorological current is often much stronger than the tidal; but as it has not the period of the latter, the measurement of the rise and fall of the tide and of the velocity of the flow and ebb could hardly be seriously affected by its presence.

The object of looking into the several sources of error has been to ascertain when the errors are small enough to be neglected rather than to attempt correcting for them in actual measurements. R. A. Harris.

February, 1904.

### SEX DIFFERENCES IN THE SENSE OF TIME.

In going over the results of a series of demonstration tests of the sense of time given to a mixed class recently, the returns from men and women were separately reduced, the summaries of which presented features of sex differentiation concerning which corroboration or revision on the part of others is sought through this note.

The test involved periods of time extending from a quarter of a minute to a minute and a half in duration. The intervals were filled in four ways: (1) The instructor read aloud to the class from a psychological work unfamiliar to its members; (2) the members of the class marked as rapidly as possible all the letter m's in a page of printed text; (3) the class waited in idleness for the period to pass by, refraining as far as possible from counting or other means of recording the lapse of time; (4) each person estimated as accurately as possible the period in question, using whatever method he had personally found most serviceable for the purpose. As there were fifteen men in the class, the tabulation of returns from the women was brought to a close when an equal number of judgments had been entered therein.

Only in the case of the one-minute period was estimation made under all four conditions mentioned. The results are presented in the following table, in which the signs plus and minus indicate respectively over- and under-estimation of the duration in terms of seconds, and the figures at the tops of the columns the series of conditions enumerated above:

Period. One Minute.

| Sex. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Men. | +29 | +1.3 | +22 | −3.5 |
| Women. | +66 | +27 | +80 | + 24 |

Incidentally, the purpose of the test was to call attention to the differences in one's estimation of time under conditions (1) and (2), and similarly in the case of (3) and (4). The relation of the members of these two pairs to each other is made apparent in the table. It is also to be noted that with the exception of the first entry in column (4), the only minus quantity in the whole series of tests, the error is throughout one of pronounced over-estimation. This tendency is very much stronger in the women than in the men, the first point of contrast in the comparison of sex differences. For this period of time the constant errors of the two sexes stand in a ratio of one to four. The clearest indication that this over-estimation of short periods of time on the part of women is a persistent habit, and not due to variable factors in the conditions of experimentation, appears in the fourth column of the table. In the case of men, keeping tally of the passing seconds results in the elimination of the positive error and the appearance of a slight under-estimation. In the case of women, on the contrary, over-estimation still persists to the amount of two fifths of the period in question; in other words, their unit of measurement is much in defect of the objective period which it is meant to represent.

The results of the various other tests made in the same series are summed in the following table, in which the same general relations are presented as in the preceding group.

| | One quarter Minute. | | One half Minute. | | One and One half Minute. | |
|---|---|---|---|---|---|---|
| Sex. | 3 | 4 | 1 | 4 | 1 | 3 |
| Men. | + 6 | +0.5 | +30 | + 3 | +19 | + 70 |
| Women. | +17 | +10 | +33 | +12 | +73 | +189 |

There is also to be considered in such a comparison as the present the average variations of the individual judgments of men and women respectively from objective accuracy, of which the formulation of their constant

errors affords no indication. These are given in the following tables, the numbers in which are, as before, in terms of seconds:

| Period. One Minute. | | | | |
|---|---|---|---|---|
| Sex. | 1 | 2 | 3 | 4 |
| Men. | 32 | 18 | 25 | 11 |
| Women. | 68 | 41 | 86 | 36 |

| | One quarter Minute. | | One half Minute. | | One and One half Minute. | |
|---|---|---|---|---|---|---|
| Sex. | 3 | 4 | 1 | 4 | 1 | 3 |
| Men. | 8 | 2 | 30 | 8 | 26 | 70 |
| Women. | 18 | 12 | 35 | 18 | 73 | 189 |

In sum, the excess of general inaccuracy in the estimation of the given periods of time on the part of women, as compared with men, is no less marked than their tendency to overestimation. The extremes of individual judgment are very great; for instance, estimation of the duration of the 1½ minute period under condition (3) ran as high as ten minutes. In the case of men the highest was three and one half minutes. The average error of judgment among the men, all periods included, was 45 per cent. of the value of the periods estimated; that of the women amounted to 111 per cent., or two and one half times that of the men.

The noting of these sex differences was incidental to the primary purpose of the test, and attention is called to them here in order that observations on the part of others may be brought into comparison with the results presented by this group of persons, all of whom had some acquaintance with psychological experimentation, but few any systematic training in laboratory methods. The writer would be glad to learn whether the judgments of children of the two sexes present a closer approximation in character than those embodied in the preceding tables; and, in case they do, whether any systematic test has been made of their progressive differentiation with advance in age. Robert MacDougall.

New York University.

## THE NATIONAL PHYSICAL LABORATORY.*

The annual inspection of the National Physical Laboratory by the general board took place on March 18, when also a large number of gentlemen interested in physical and mechanical science accepted the invitation of Sir William Huggins, president of the Royal Society, and of Lord Rayleigh, president of the general board, to examine the work carried on by the institution at Bushy House. All the departments of the laboratory were thrown open to the visitors, who were free to go where they pleased, and who found Dr. R. T. Glazebrook, the director, and his assistants ready to give every explanation of the apparatus displayed and the purposes to which it was being placed. The report for 1903 contains full details of the work which was carried out during that year, and also an outline of the program for the present year. In the engineering department this includes a continuation of the research on wind-pressure and of that on the mechanical properties of nickel-steels, undertaken jointly with Mr. Hadfield; an inquiry into the specific heat of superheated steam on a large scale; the erection and testing of the new screw-cutting lathe, for which a special house has been built and which is to be used for making standard leading screws on behalf of the Standard Leading Screw Committee of the War Office; and the construction of a machine for determining the friction of bearing surfaces. In the physics department, among other things, the construction of a standard ampere balance, together with various electrical tests, is to be undertaken for the engineering standards committee; various methods of measuring temperatures between 1,400 C. and 1,800 C., and the suitability of different glasses for high temperature thermometry, are to be investigated; the standardization of the steel yard and nickel meter is to be completed, and the urgently required work of comparing an 'end' yard and an 'end' meter with the 'live' standards, and of calibrating the subdivisions of each, is to be undertaken; and an inquiry is to be initiated into the conditions in which the pentane lamp may be treated as a standard, and measurements made of the refractivity and absorption of various glasses used by opticians.

* From the London *Times*.

During last year the number of tests made in the engineering and physics departments was 1,330, and the fees received amounted to £350, a sum of £536 being also received for researches undertaken in the laboratory; in the nine months of 1902 during which those departments were open the tests numbered only 269 and the fees were £69. In addition, many applications were made for tests which the laboratory was unable to undertake, owing to lack of equipment; among these were tests on wire and wire ropes, on rubber, on the tensile strength of metals after special hardening, on cement and stone, on very high-speed anemometers, and on alternate-current instruments of all kinds. In the engineering department the need of a powerful testing machine was greatly felt, and work had constantly to be declined which would have been accepted if such a machine had been available.

But while the work of the laboratory has prospered, its financial position gives rise to grave anxiety. The receipts for 1903 were £10,200 and the expenditures £10,306, the deficiency thus being £106. In the preceding year the receipts were £9,314 and the expenses £9,235, the balance being £79. In addition, £1,036 was spent in 1903 on equipment out of the accumulations transferred from the Kew committee. Thus the laboratory is spending more than its income, and in the opinion of the executive committee a further increase of expenditure will be necessary in the present year. By drawing on the available balance of £2,379 it will be possible to go on for another year, but the committee feels that the time has come when the financial position must be reconsidered. This is the more necessary since the period for which the grant of £4,000 was originally made ends next September, though the Royal Society has arranged with the treasury that it shall continue till April, 1905, and that a scheme for the future shall be considered by the treasury. The committee holds that an increase of funds is necessary even to maintain the work as at present, and a further increase of work for which there is a demand is to be carried out. It also thinks that, for the sake of permanence, the positions of the senior members of the staff should be made more secure, and that the stipends now paid to the assistants—with one exception £200 a year—are not commensurate with the work and are insufficient to retain for long the services of suitable men, while in addition the staff is now too small. It points out that similar institutions in other countries obtain more assistance from the state; in particular, the Reichsanstalt in Berlin alone gets £16,000, and the annual grants to the various institutions at Charlottenburg, which together cover the ground covered by the National Physical Laboratory, comes to about £40,000.

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## *THE BERMUDA BIOLOGICAL STATION FOR RESEARCH.*

Harvard University and New York University again unite with the Bermuda Natural History Society in inviting zoologists and botanists to spend six weeks in the temporary biological station located, as last year, at the Flatts, Bermuda.

Venerable George Tucker, Archdeacon, president of the Bermuda Natural History Society.

Hon. W. Maxwell Greene, Consul U. S. A., vice-president of the Bermuda Natural History Society.

F. Goodwin Gosling, honorary secretary of the Bermuda Natural History Society.

E. L. Mark, director of the Zoological Laboratory, Harvard University.

C. L. Bristol, professor of biology, New York University.

The Bermuda Islands are about seven hundred miles southeast of New York. They are nearly due east from Savannah, due south from Halifax, and due north from Porto Rico, being about equidistant from these three points. Since their discovery, in the seventeenth century, they have belonged to Great Britain, which maintains an important naval and military station there.

The climate is mild during the whole year, not being subject to the extremes that are found either in the temperate or tropical regions. The summer temperature is rarely higher than 85° F., and the winter rarely below 50° F. In the summer light breezes are almost constant and help to make the climate quite as comfortable as at many seaside resorts.

The soil is very porous, so that there are no streams, all the fresh water used in the islands being rain water caught on white-washed stone roofs and stored in covered cisterns. Endemic malaria and tropical fevers are unknown. The roads are excellent, and bicycles are much used.

The marine fauna and flora are abundant and such as are characteristic of coral reefs. The experience of last summer shows that there are available for study a great many varieties of marine forms, and that most of them occur in great abundance. The plan adopted in 1903 of recording the precise locality in which different organisms were found will greatly aid the investigator in procuring such material as he may desire.

Bermuda is reached in about sixty hours from New York by the vessels of the Quebec S. S. Co., which leave pier No. 47, North River, foot of West Tenth Street. During June, July and August, S. S. *Trinidad* is scheduled to sail from New York on the following dates: June 4, June 18, July 2, July 16, July 30, August 13; and returning to leave Hamilton, Bermuda, on June 11, June 25, July 9, July 23, August 6, August 20 and September 3.

By special arrangements with the Quebec S. S. Co., and the Hotel Frascati, the total expense of transportation from New York and return, and for board and lodging—but not washing—for six weeks at Bermuda, will be one hundred dollars. Board and lodging in excess of the period of six weeks will be charged for at the rate of ten dollars per week, but no arrangement will be made for a period of less than six weeks. This price is based on the understanding that two persons will occupy a room together. The payment of one hundred dollars entitles the applicant to the privileges of the laboratory and ample facilities for collecting and studying the animals and plants of the coral reefs, lagoons and shores.

The laboratory is a new and well-constructed building, and is furnished with all the ordinary glassware, reagents and apparatus provided in modern marine laboratories; but microscopes, dissecting instruments, slides and coverglasses are not supplied by the station. The means of collecting include a steam launch forty-five feet long and crew, a fish-well sailboat and crew, row-boats, a two-horse carriage carrying ten or twelve persons, nets, seins, water glasses, towing and dredging apparatus, etc.

The postoffice address of the station is Flatts, Bermuda.

Zoologists and botanists who desire to take advantage of the opportunities offered by the station should send applications as early as possible, and not later than June 1, either to Professor E. L. Mark, 109 Irving Street, Cambridge, Mass., or to Professor C. L. Bristol, New York University, University Heights, New York City. Applicants not officially connected with any scientific institution, or with any university or college in the capacity of instructors, should send letters of endorsement from those under whom they have studied. Applications should in all cases state the nature of the work proposed, and if possible the precise problem or problems contemplated. It will be possible in some cases to provide the use of books and monographs, if applicants indicate those which they desire but can not themselves procure. It should be understood that the opportunities offered are for investigations and that no formal instruction will be given. Each application should be accompanied with the sum of fifty dollars. If the application is accepted, a ticket and state-room assignment will be promptly forwarded to the applicant. Otherwise the fifty dollars will be returned. The remaining fifty dollars is to be paid upon arrival at Bermuda. No reduction from the sum named (one hundred dollars) can be made for any cause.

The date of sailing from New York is July 2. If a change in this date is necessitated by any change in the schedule of the Quebec S. S. Co., timely notice will be sent to every applicant.

Biologists who intend to take away from Bermuda collections, should ship to Bermuda their own alcohol, formol and cans for transporting specimens. Tax-free alcohol can be exported from the United States, a certificate of landing in Bermuda being all that will be

required in addition to the dealer's bond. The Quebec S. S. Co. agrees to charge for transportation only one-half its regular tariff rate on all scientific collections, apparatus, equipment, etc., both from New York to Bermuda and from Bermuda to New York.

Drafts on New York, gold coin and bank notes are current in Bermuda at $4.80 to the pound sterling; silver coin is not current.

If further information is desired, inquiries may be addressed to either of the undersigned.

E. L. MARK,
C. L. BRISTOL.

April 1, 1904.

## SCIENTIFIC NOTES AND NEWS.

AT the meeting of the National Academy of Sciences last week members were elected as follows: Professor William Morris Davis, Harvard University; Professor William Fogg Osgood, Harvard University; Professor William T. Councilman, Harvard Medical School; Professor John U. Nef, University of Chicago. The foreign associates elected were: Professor Paul Ehrlich, Frankfurt; Professor H. Rosenbusch, Heidelberg; Professor Emil Fischer, Berlin; Sir William Ramsay, London; Sir William Huggins, London; Professor George H. Darwin, Cambridge; Professor Hugo de Vries, Amsterdam; and Professor Ludwig Boltzmann, Vienna. The Draper gold medal was presented to Professor George E. Hale, of the Yerkes Observatory, Wisconsin, for his researches in astrophysics.

THE Station for Experimental Evolution of the Carnegie Institution has established the class of associates including biologists of this country who are engaged in work in experimental evolution and who receive especial assistance from the Carnegie Institution or its station for this work. The station and its associates will work in a cooperative way, especially in the exchange of material for investigation. The following have become associates of the station for the year 1904: Professor N. L. Britton, New York Botanical Garden; Professor W. E. Castle, Harvard University; Professor H. E. Crampton, Columbia University; Professor D. T. MacDougal, New York Botanical Garden; Professor E. L. Mark, Harvard University; Professor W. J. Moenkhaus, Indiana University; Professor W. L. Tower, University of Chicago; Professor E. B. Wilson, Columbia University.

THE Prussian gold medal for science has been presented to Professor Wilhelm Hittorf, the eminent physicist and chemist, on the occasion of his eightieth birthday.

M. C. E. Bertrand has been elected a corresponding member of the Paris Academy of Sciences in the section of botany.

MISS N. M. STEVENS, A.B. (Stanford), Ph.D. (Bryn Mawr), has been appointed Carnegie research assistant and reader in experimental morphology at Bryn Mawr College.

ASSOCIATE PROFESSOR GEORGE C. PRICE, of the department of physiology of Stanford University, who has been in Europe on his sabbatical leave of absence, recently arrived in Boston, where he will spend the next three months at work in the embryological laboratory of Professor C. S. Minot of the Harvard Medical School.

PROFESSOR G. N. CALKINS, of Columbia University, will spend the summer abroad, visiting zoological laboratories.

MR. RAYMOND S. DUGAN, formerly assistant to Professor Todd, in Amherst College Observatory, later for three years in charge of the Beyrout Observatory and now assistant to Dr. Max Wolf in Heidelberg, has discovered a new planet which he has named Amherstia, in honor of his Alma Mater. Mr. Dugan graduated at Amherst College in 1899.

THE annual congress of French learned societies met at the Sorbonne, Paris, beginning on April 5. M. Levasseur presided.

THE congress of the French societies of geography was held at the beginning of the present month at Tunis under the presidency of M. Pichon.

DR. BOWDLER SHARPE, of the British Natural History Museum, has lately returned to England with some rare specimens of birds from the Cayman Islands.

DR. M. MIYAJIMA, instructor in the Imperial Hygienic Institute of Tokyo, has reached St. Louis to supervise the installation of the ex-

hibit of tetanus germs and other bacilli to be made by the institute.

Dr. H. W. Wiley delivered a lecture at Lehigh University on April 15, on the 'Work of the Bureau of Chemistry,' and before the Sigma Xi Society of Yale University on April 16, on 'Food Adulterations and how to Study their Effects.' After the lecture a smoker was held at the Graduates Club.

Professor E. Rutherford, of McGill University, lectured on 'Radium' to a large audience at the Ohio State University on April 12. The lecture was given under the auspices of the Society of the Sigma Xi.

Sir Henry Thompson, the distinguished surgeon, has died at the age of eighty-four years.

The Carnegie Institution has made a grant of $1,500 in continuation of last year's grant aiding the new reduction of Piazzi's 160,000 star observations. This work, under the direction of Dr. Herman S. Davis, Gaithersburg, Md., is now well advanced, previous assistance having also been rendered by Miss Bruce and by the National Academy of Sciences which continues its aid. A reobservation of all the southern stars of Piazzi's catalogue by Professor Tucker has recently been issued as Vol. VI. of the *Lick Observatory Publications* and a similar work for all the northern stars by Professor Porter will be an early publication of the Cincinnati Observatory. Other cooperators, both in this country and in Italy, are expected to complete the entire work in five years or less. It has now been in continuous progress nearly eight years.

A bill is before Congress appropriating one million dollars to be used in the erection of a building for the United States Geological Survey.

Plans have been prepared for a new hospital for New York City to cost $11,000,000.

The State Cancer Laboratory at Buffalo will receive its annual appropriation of $15,000 from the New York legislature. The chairman of the senate finance committee, who cut the item out, finally agreed that it be retained in the supply bill.

The large collection of North American Diptera which was presented to the American Museum of Natural History recently by Professor William M. Wheeler, curator of invertebrate zoology, has been combined with the collection formerly the property of the museum and is ready for use by students.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

The Iowa legislature has made the following appropriation:

| | |
|---|---|
| **IOWA STATE COLLEGE.** | |
| Annual support fund | $50,000 |
| Iowa Agrl. Exp. Station, annually | 15,000 |
| Engineering Experiments | 6,000 |
| For the completion of the central bldg | 95,000 |
| For central heating plant | 54,500 |
| For good roads experimentation | 7,000 |
| For dairy building and equipment, and farm | 84,500 |
| For additional support for repair fund, annually | 4,500 |
| **IOWA STATE UNIVERSITY.** | |
| Annual support fund | $25,000 |
| For the repair and contingent fund, annually | 7,500 |
| $143,000 divided as follows: | |
| Library | 20,000 |
| Equipment and supplies | 20,000 |
| Paving for tunnel and extension | 18,000 |
| Land | 25,000 |
| Engineering building | 50,000 |
| For dam and water power | 10,000 |
| **IOWA STATE NORMAL SCHOOL.** | |
| Annually hereafter, increase support fund | $35,000 |
| For the following purposes ($13,000): | |
| Librarian and two assistants for library | 5,000 |
| Improvement of grounds | 3,000 |
| For fuel, engineer and fireman | 5,000 |

At the recent convocation of the University of Chicago, President Harper acknowledged a gift of $5,000 for special investigation in the department of physics, by the president of the Board of Trustees, Mr. Martin A. Ryerson, and a gift of $10,000, by Miss Helen Snow as a memorial to George W. Snow, her father, to rebuild the horizontal telescope at Yerkes Observatory, which was injured by fire.

Dr. Thomas L. Watson, since 1901 professor of geology in Denison University, has resigned to accept the chair of geology in the Virginia Polytechnic Institute, at Blacksburg, Virginia.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 6, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE GENERAL MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY.*

A GENERAL meeting of the American Philosophical Society which undertakes to bring together the members from widely different parts of the country has now become an annual event of the week following Easter. All the general meetings which have been held so far have been highly successful and profitable and have served to arouse much interest in the history and purposes of this organization, which is the oldest scientific society on this continent. The interest in the meeting this year was in no respect inferior to that of former years, as was evidenced by the large attendance of non-resident members and by the extensive program of scientific papers.

That these meetings fill a real need in the scientific life of this country is the opinion of most of those who have attended them. This society, more than any other in this country, with the possible exception of one, stands for the solidarity of human learning. A lively appreciation of this fact is awakened by an inspection of the contents of the long series of volumes issued by the society during a period of more than one hundred and fifty years, as well as by a glance at the varied character of the papers offered at the general meeting. There are few if any organizations in this country which attempt to cover the same field. The American Association for the Advancement of Science and the National Academy of Sciences are devoted to scientific subjects in the stricter sense. The American Philosophical So-

ciety, on the other hand, is devoted not merely to the sciences, but to the humanities and literature as well. It has been objected that such an ambitious program belongs rather to the eighteenth century than to the twentieth, and certainly the numerous technical societies which have arisen in relatively recent years bear witness to the increasing tendency to specialization in all fields of learning. It does not, however, follow that the growth of these technical societies has supplanted the need of more general ones. It is of course desirable that the papers presented at the meetings of the American Philosophical Society should be of broad and general interest, and such they generally are.

These general meetings afford the opportunity of hearing and discussing recent advances in various subjects and also of meeting and becoming acquainted with eminent authorities in those fields; to many persons these have seemed to be attractions of no small order.

The meeting of the society was held this year on April 7, 8 and 9, in the historic home of the society on Independence Square, Philadelphia, where regular meetings have been held for about one hundred and twenty years. The meeting was called to order on Thursday morning with a brief address of welcome by the president, Professor Edgar F. Smith, after which the following papers were presented in the order named:

*The Rôle of Carbon:* Professor Albert B. Prescott, Ann Arbor, Mich.

The central position of the element carbon among the others as shown in the periodic system, together with its innate character, preeminent rather than exceptional in comparison, together give its capacity for combination. Through studies of carbon compounds chemistry at large has been enriched by facts of molecular constitution, correlated with all physical constants. When the nature of the living proteids shall become known molecular constitution will be included in that knowledge, and the atom of carbon or its theoretical equivalent will have its part in the discoveries then made.

*Dimethyl Racemic Acid, its Synthesis and Derivatives:* Professor H. F. Keller, Philadelphia.

The subject of this paper is an experimental study of a crystallized acid which had first been obtained, in very small quantities, by Professor Fitting and the author in an investigation upon diacetyl, an important compound of carbon discovered by them. The present paper describes the synthetic preparation of the acid on a larger scale, and by an improved method, and supplies more complete data concerning its physical and chemical characters. It records the preparation of a number of new salts and many analytical results, confirming the deductions which had been drawn from scanty observations in the original research.

*Sources of Error in the Determination of the Atomic Weight of Nitrogen:* Theodore W. Richards, Cambridge, Mass.

On comparing Stas's and Scott's analyses of ammonic bromide, it is shown that while Stas probably failed to purify ammonia with sufficient care, Scott, although working with purer ammonia, used bromine which was less pure. Thus Stas's results would yield too high an atomic weight of nitrogen, and Scott's one too low. The study of the other available data, including the results of Ramsay and Aston and some preliminary Harvard work, seems to show that the assumption of inconstancy in the atomic weights is not demanded by the facts, and that the atomic weight of nitrogen is between 14.02 and 14.04.

*The Constituents of the Venom of the Rattlesnake:* Professor John Marshall, University of Pennsylvania.

Researches on the constituents of the venom of the rattlesnake are not as numerous as those on the physiologic action of the venom and those bearing upon attempts to discover an antidote. The most comprehensive research on the constituents of the venom of this snake was made by Drs. Weir Mitchell and Reichert in 1886. Since then a better knowledge of albuminous substances has been obtained, newer classifications of these substances have been made and more accurate methods for their separation and identification have been devised.

All of the substances hitherto separated from the venom of this snake by the methods employed were toxic. The toxicity of the substances separated is believed by the author to have been due to an admixture of a toxic substance which was precipitated with the non-toxic part as an adherent material.

By the method of separation by fractional precipitation by means of ammonium sulphate the author has been able to separate the venom (using that of the *Crotalus adamanteus*) into three fractions. Of these three fractions one is toxic and two are non-toxic. The first fraction of the series of three was separated from the venom, while in one per cent. sodium chloride solution by the very slow addition of saturated ammonium sulphate solution with constant, rapid stirring by means of a mechanical stirrer until the venom solution was saturated with ammonium sulphate solution to the extent of 4.5/10. The first fraction consists of euglobulin and pseudoglobulin, is white and non-toxic. The second fraction was obtained from the filtrate from the first by saturation to 6/10 with ammonium sulphate, is yellow and is toxic. Whether it is a chemical individual or a mixture is still under investigation. The yellow coloring matter was separated and is soluble in absolute alcohol, producing a greenish fluorescent solution. It is not a lipochrome, nor bile coloring matter, nor an ordinary coloring matter. It is non-toxic.

The third fraction was obtained from the filtrate from the second fraction by saturating with crystals of ammonium sulphate. It is white, non-toxic and consists of albumin.

The author was unable to detect any albumoses or peptone in the venom.

*The Atomic Weight of Tungsten:* Professor Edgar F. Smith and Dr. F. F. Exner, Philadelphia.

Our study, extended over a long period, has revealed:

1. That it is quite doubtful whether any chemists who in the past occupied themselves with a redetermination of the atomic weight of tungsten have worked with pure substance. Tungstic acid is prone to form 'complexes.' It was found that if the acid contain no iron, for instance, but be digested with acids, *i. e.*, hydrochloric or nitric acid, in which iron is present, the latter will enter the tungstic acid. Iron and manganese are eliminated from the acid with the greatest difficulty. In the earlier work there is no evidence of their removal; neither do we discover that vanadium and phosphorus had been considered as present, yet in purifying ammonium paratungstate by recrystallization alone it was found that the tenth recrystallization showed vanadium.

2. The slimy, greenish or bluish-white masses believed to be 'para-tung-states' because of their great insolubility are probably 'complexes.'

3. The use of pure sodium carbonate (two per cent.) to dissolve tungsten trioxide gives an excellent means of ascertain-

ing when the iron, manganese and silica are fully removed, but that its development into a method for the determination of the atomic weight of tungsten is not at all probable.

4. The plan of digesting pure ammonium paratungstate with nitric acid, then evaporating to complete dryness and gently igniting affords pure oxide.

5. That porcelain vessels are preferable to those of gold, silver or platinum for the ignition of ammonium paratungstate and tungstic acid.

6. That the oxidation of metal (method 2) leads to reliable atomic numbers when the material is pure.

7. That tungsten hexachloride can be completely transposed into pure oxide with water and a little nitric acid.

*Trisulphoxyarsenic Acid:* Professor LeRoy W. McCay, Princeton.

This paper explains how magnesium salt of trisulphoxyarsenic acid is formed. This salt has the composition represented by the formula $Na_3AsOS_3 + 11H_2O$. The tertiary potassium salt is prepared in an analogous manner. Two double salts $NaSrAsOS_3 + 10H_2O$ and $KBaAsOS_3 + 7H_2O$ have also been prepared. Methods for separating trisulphoxyarsenic acid from monosulphoxyarsenic and disulphoxyarsenic acid have been worked out and the behavior of the compound toward strong mineral acids is now under investigation. This work was done conjointly with Dr. William Foster, Jr., of Princeton University.

*The Expansion of Algebraic Functions at Singular Points:* Professor Preston A. Lambert, Bethlehem, Pa.

In this paper the author bases the expansion in series of algebraic functions at singular points on that application of McClanim's series which, at the last general meeting of the American Philosophical Society, was developed for the determination of all the roots of a numerical equation. The method is more direct than the methods employed for this purpose by either Puiseux or Nöther.

*The Continuum and the Theory of Masses:* Professor I. J. Schwatt.

The theories of continuity as given by Peano, Borel, Couturat, Poincaré and others are viewed in the light of Cantor's ideas. The classification of the different kinds of numbers and their relation to the continuum is given. The relation between the $m$-fold and $n$-fold space and the continuity of these spaces is studied.

*Biblical Pessimism:* Professor Paul Haupt, Baltimore. Read by title.

*The Ripening of Thoughts in Common:* Professor Otis T. Mason, Washington, D. C.

Thoughts in common and the activities linked with them are spoken of under the heads of biology, speech, industries, fine art, social life, learning and lore and religion. Activities which are purely biological thoughts-in-common are shared with the animals. Speech is considered as the first occasion of thoughts. Industries of life give rise to much simultaneity and identity of mental operations. The esthetic faculty affords most wonderful examples of the force of emotions felt in common. The first society developed a vast number of thoughts in common that have persisted in all ages and areas. In learning and lore and in religion the same similarity of thought is pointed out.

THURSDAY, APRIL 7.

*Afternoon Session—2 o'clock.*

Vice-President Scott in the chair.

*An Attempt to Correlate the Marine with the Fresh and Brackish Water Mesozoic Formations of the Middle West:* Professor JOHN B. HATCHER, Pittsburgh, Pa.

1. Marine and fresh-water or other non-marine deposits when present even in the same region, the one superimposed upon the other, do not necessarily represent distinct time intervals. When considered as formations they may have been deposited contemporaneously and may represent approximately the same time interval.

2. The Atlantosaurus beds and Dakota sandstones are considered as the possible equivalents of the Jurassic and Lower Cretaceous.

3. The relations of the Eagle sandstones, the Judith River beds and the Laramie to the Colorado and the Montana formations are pointed out.

*The Miocene Rodentia of Patagonia:* Professor WILLIAM B. SCOTT, Princeton, N. J.

*Recent Advances in our Knowledge of the Evolution of the Horse:* Professor HENRY F. OSBORN, New York.

The special explorations and studies on the evolution of the horse in the American Museum of Natural History, under the fund donated by Mr. William C. Whitney for this purpose, have considerably extended our knowledge of the evolution of the horse in America in recent years.

The Oligocene horses have been revised and are shown to embrace a large number of types, among which are the ancestors of at least two of the distinct lines of Miocene horses. In the Miocene it is found that the genera *Merychippus, Protohippus* and *Hypohippus* described by Leidy in the middle of the last century all represent distinct lines or stages of evolution.

The museum exploring parties under Mr. J. W. Gidley secured complete skeletons of *Mesohippus bairdii* from the Upper Miocene, the new genus *Neohipparion whitneyi* and the Lower Pleistocene horse, *Equus scotti.* The existence of three and possibly four distinct but contemporaneous lines of Miocene horses has been demonstrated.

The cause of the extinction of the Pleistocene horses in America remains a mystery. No horse remains are found recorded with human remains, as is the case in South America. It is also not positively demonstrated that the modern horse, *Equus caballus,* originated in North America. This remains an open question until we know more of the geology of Asia.

*The Silurian Fauna of Arkansas:* Mr. GILBERT VAN INGEN. (Introduced by Professor W. B. Scott.)

*The Yukaghir Language:* WALDEMAR JOCHELSON, New York. (Introduced by Dr. Franz Boas.)

The morphological peculiarities of this language may be summed up in the following main propositions.

Word-formation is accomplished mainly by means of suffixes; but prefixes are also used (almost exclusively in connection with verbal forms). In this respect the language differs from those of the Ural-Altaic group, which uses suffixes only, and approaches the American languages.

The possessive suffix of nouns is but little developed (except in the third person); the language thus differing from the Ural-Altaic, as well as from the Eskimo dialects.

Sound-harmony of vowels (*a* and *o* should not occur in the same word) is little developed, and in this respect the language resembles some of the Indian dialects, but differs absolutely from the Ural-Altaic languages with their intricate system of

vowel-harmony. For instance, an important feature of the vowel-harmony of the latter group of languages consists of the adaptation of the suffix vowels to the vowel of the root, which never changes. The vowel of the first syllable thus governs all the rest of the vowels, no matter what their number may be. In the harmony of the Yukaghir language, the root-vowel frequently adapts itself to the vowel of the suffix. Besides, in the plural forms of the personal pronouns (met, mit; tet, tit; tudel, titel) an attempt may be noticed in the language to derive new forms by means of changes of vowels within the root (the method of Semitic languages) without any additions from outside, a feature of which traces may be found in two other so-called 'isolated' Siberian languages—that of the Kott and the Ostyak from Yenisei.

The difference in the conjugation of transitive and intransitive verbs which we have in the Yukaghir language is a feature common to almost all American languages. The same may be said of the capacity of bases of transitive verbs to change into intransitive by means of suffixes, and *vice versa*.

Suffixes of purely verbal forms are different from case-suffixes, and they can not be brought in connection with personal pronouns.

A necessary element of plurality is the sound *p*; while that of futurity, *t*. In the Chukchee and Eskimo languages *t* constitutes the element of plurality, and in the Koryak language it forms the element of the dual number.

Adjectives, being verbal forms, do not undergo any inflections.

There is no difference between animate and inanimate objects, as is the case in some Indian dialects.

The feature known as 'polysynthesis' in American dialects, and which consists of a combination of two or more uninflected bases into one word, in which one of the bases expresses the principal idea, and is put at the end of the word, while the other bases figure as secondary definitive ideas, is also to be met with in the Yukaghir language.

It is true that there is no actual incorporation to be found in the language; neither pronouns nor nouns, when direct or indirect objects, are incorporated in the predicate; but the nature of the syntactical construction of the Yukaghir language is akin to incorporation. The verb plays the main part in the sentence. It is always placed at the end of the sentence, being preceded, first by the subject with all its modifiers, then by the direct and indirect objects with their modifers, then by the adverbs. If the subject is not accompanied by any modifiers, and it is known from the sense of the story who the acting person is, then it is usually dropped. The subject very often does not assume the element of plurality, though there are many acting persons, as long as the sense of plurality is expressed by the verb.

*The Horizontal Plane of the Skull:* Dr. Franz Boas, New York.

*Evening Session—8 o'clock.*

At the Free Museum of Science and Art, University of Pennsylvania, President Smith in the chair.

*Pompeii and Saint Pierre: an Examination of the Plinian Narration, and other Studies* (with lantern slide illustrations): Professor Angelo Heilprin, Philadelphia.

A reception was given in honor of the members of the society and the ladies accompanying them, at 9 o'clock, at the Free Museum of Science and Art.

FRIDAY, APRIL 8.

*Morning Session—10 o'clock.*

Vice-President Barker in the chair.

*The Reflex Zenith Tube:* Professor CHAS. L. DOOLITTLE, Philadelphia.

More than fifty years ago an instrument known by this name was constructed from designs by Mr. J. B. Airy for use at Greenwich. The instrument consists of a telescope fixed in a vertical position. A basin of mercury below the objective at a distance equal to one half its focal length reflects the rays from a zenith star upwards, bringing them to a focus immediately in front of the objective. A micrometer thread moving in the focal plane furnishes the means of measuring the positions of stars which culminate sufficiently near the zenith to be within the field of view. The instrument was designed especially for use with $\gamma$ Draconis, which culminated very near the zenith of Greenwich. The object was a more accurate determination of the constant of aberration, and incidentally the star's parallax. So far as known this is the only instrument of this description ever constructed.

In the course of the long series of latitude observations carried on at South Bethlehem, and afterwards at this place, anomalous results have appeared from time to time which seem to merit further study. The practical method for attacking the problem appears to be to carry on two series of observations simultaneously, employing two instruments of different construction. With this in view Mr. Joseph Wharton has generously provided the means for installing a reflex zenith tube of eight inches aperture at this place. Warner and Swasey have this instrument well advanced and it is hoped that it may be in practical operation at an early day.

It will be used in connection with the zenith telescope, which has been thoroughly renovated and the optical power increased so that stars as faint as the eighth magnitude may be employed. It is hoped that simultaneous observations with the two instruments may be carried on for two or three years at least.

*Faint Double Stars:* Mr. ERIC DOOLITTLE, Philadelphia.

The table of limiting distances given by Mr. R. T. A. Innes, within which a pair of stars is to be considered as a double star and entered into the catalogues, was examined, and the opinion was expressed that the limits of this table were too narrow. In support of this opinion it was pointed out that of the 175 Burnham stars known to be binary, 16 would have been excluded by the above criterion, and attention was called to the triple systems $\mu$ *Herculis* and *o Eridani,* which exceed the limits of the table. The 1,290 Burnham stars were examined as to proper motion, and it was shown that an average of 8 out of 51 minute stars measured in the vicinity of a bright star have an independent proper motion of their own, while an average of 27 out of 51 are carried along with the bright star; the stars examined in each case exceeded the limits of the above table. It was pointed out that many cases of proper and orbital motion might, therefore, reasonably be expected among the faint stars, and the importance was urged of securing an initial series of measures to serve as a basis for the investigation of their future motion.

New elements of $\mu$ *Herculis* were given, and the recent measures of this system and of Krueger 60 and *o Eridani* secured at the Flower Observatory were referred to.

*On the Spectra and General Nature of Temporary Stars* (with lantern slide illustrations): Professor WILLIAM W. CAMPBELL, Mt. Hamilton, Cal.

Our knowledge of the visual spectrum of the Orion nebula began with the invaluable pioneer observations of 1864–65 by Sir William Huggins. The first photographs

of the spectrum were obtained independently and simultaneously in March, 1882, by Sir William Huggins at Tuke Hill, London, and by Dr. Henry Draper in New York.

The Tuke Hill spectrograms of the nebula differed widely from each other, even in the most prominent features; from which the conclusion was drawn by many persons that the spectrum of the Orion nebula varies rapidly with time.

On account of the great value of accurate knowledge at this point in stellar evolution, it was desirable that the striking discrepancies shown should be explained and removed as promptly as possible. With this end in view an excellent series of spectrograms of the four Trapezium stars and four neighboring stars was secured in December, 1903, and January, 1904. These compared with spectrograms previously obtained by Campbell at the Lick Observatory, and by Keeler at Allegheny, fail to confirm the changes formerly suspected.

The discrepant Tuke Hill results for the nebula seem to be due to variations in the time of exposure, to fortuitous arrangements of the silver grains such as one must be on his guard against in under-exposed and over-developed negatives, and to the fact that the commercial plates in the eighties were considerably less sensitive than those of the last decade.

In case of the Trapezium stars, every exposure on the star is at the same time an exposure on the nebula. The particular instrumental arrangement and time of exposure may in one case emphasize the spectrum peculiar to the nebula, and in another that of the star, with the result that spectra obtained with different instruments and under different conditions will possess comparatively few points of resemblance. We can safely say that these stars are closely related to the nebula in chemical constitution and relatively closely in physical condition.

The results of this investigation were communicated to Sir William Huggins for criticism and comment. He is inclined to accept in the main the conclusions reached, with, perhaps, some reservation regarding some of the many points involved.

*Systems of n Periplegmatic Orbits:* Professor EDGAR ODELL LOVETT, Princeton. (Introduced by Professor C. L. Doolittle.)

The paper on systems of periplegmatic orbits was inspired by Dr. G. W. Hill's memoir on pairs of such orbits which appeared in the current volume of the *Astronomical Journal.* The notion of a periplegmatic orbit is due to Gyldén and their theory has been elaborated in the introductory chapter of his treatise on absolute orbits. The successive sections of the present paper are occupied with triple and $n$-ple systems of plane periplegmatic orbits. The method of discussion employed is essentially that used by Hill and the generalizations constructed are suggested very naturally by the examples of his memoir. The concluding paragraph of the note has to do with certain pairs of entangled orbits, periplegmatic or otherwise, whose determination depends either on elliptic functions or those new uniform transcendental functions recently discovered by Painleve to which he is devoting a series of memoirs in the *Acta Mathematica.*

*Palladium:* Mr. JOSEPH WHARTON, Philadelphia.

The rare metal palladium belongs to the platinum group, yet in some respects resembles silver also. It usually occurs as a companion to platinum and thus exists in many places, but in such extremely small quantity that until lately the reworking of platiniferous residues from the various mines supplied most of what appeared.

The prevailing scarcity of platinum now directs attention to palladium as a practicable substitute; for it has many of the good qualities of platinum, while its price is rather lower.

Both platinum and palladium occur in all the numerous nickel mines found among the Laurentian and Huronian rocks in the province of Ontario, Canada; the quantity of each of those metals varying from a mere trace to one or more ounces per ton, the average for each metal being about one hundredth of an ounce per ton.

Those Canadian ores carry nickel, copper, silver, gold, platinum, palladium, iridium and rhodium. The percentages of the precious metals are extremely minute and the various processes by which all these metals are recovered are naturally complicated and delicate; yet as approximately 300,000 tons of these ores are treated annually by the Orford Copper Company, which owns most of those mines, that company now produces about 3,000 ounces of palladium annually. The reports of the Canadian government upon the metallic and mineral resources of the dominion have never mentioned palladium as one of those resources.

It is not known in what condition the palladium exists in that region, but as platinum has been found there in the form of platinum arsenide, it seems probable that palladium may occur in the same condition.

Among the valuable characteristics of this metal are its hardness, ductility and malleability; it is also so non-corrodible that a polished sheet of it may long remain exposed to chlorine and hydrogen sulphide gases without tarnishing or losing its polish.

*Radium from American Ores:* Professor A. H. PHILLIPS, Princeton, N. J.

The mineral from which the radium was separated was carnotite, a new mineral described in July, 1899, and found as yet only in the western part of Colorado and adjacent counties of Utah. In composition it is a potassium uranyl vanadate with three molecules of water of crystallization.

In October, 1902, twenty-five pounds of this ore were obtained from Richardson, Utah. This ore contained less than ten per cent. of carnotites. Its activity as compared to uranium nitrate was .40.

This was treated with concentrated acids, as it was thought that particularly nitric acid would dissolve the radium salts.

After washing the insoluble residue the solutions were concentrated. As the ore contained very little barium, some barium chloride was added as a carrier for the radium; the sulphates were then precipitated, barium separated and obtained free from other bases by the ordinary methods.

The barium carbonate dissolved in the least possible quantity of hydrochloric acid and fractioned by crystallization three times. The final product weighed a little less than one half gram and gave an activity compared to uranyl nitrate of 1,500. The residual chlorides were recovered and weighed very near two grams, and as measured by G. B. Pegram, of Columbia, their activity compared to uranium was 365.

With these results, had a ton of ore been used, and if it were possible to concentrate the activity into one gram of barium chloride, it would give an activity of approximately 60,000.

In February, 1904, 3.5 kilos of ore were obtained from Montrose County, Colorado. This ore before treatment gave an activity of 1.71 compared to uranyl nitrate. After treatment with dilute acids the residue gave an activity of 1.40. There was recovered from these acid solutions 3.8 grams of barium carbonate with an activity of 35.8. It was expected that the activity could be concentrated, or the radium separated from the insoluble residue by boiling with so-

dium carbonate, the work on this last specimen not having been completed. If a ton had been used in the solution and the radium concentrated it would yield a gram of barium chloride of an approximate activity of 11,300. Thus showing that while the radium is dissolved to a large extent in concentrated acids from the ores, even the dilute nitric acid dissolves it in considerable quantity, and undoubtedly, in the preparation of uranium salts, this radium would be carried by the uranium, which to a certain extent would explain the varied activity of some uranium salts.

It was thought that the above results were sufficient to prove that carnotite was a carrier of radium to a considerable extent, and would prove a valuable source of radium.

At the executive session which followed the preceding program the committee appointed at the last general meeting to prepare a plan for the appropriate celebration of the two hundredth anniversary of the birth of Benjamin Franklin reported the following plan:

For the evening of the first day, a meeting of the society with a reception of delegates and representatives accredited to the society; presentation of addresses; adjournment, followed by a general reception.

For the succeeding day in the morning, commemorative addresses on Franklin, covering his services—as citizen and philanthropist; as printer and philosopher, and as statesman and diplomatist; these exercises to be followed by a banquet in the evening.

That the society ask congress to strike a medal in honor of the occasion, of which a gold impression shall be presented by the president of the United States to the French Republic, and a number of bronze impressions shall be distributed under the direction of the president of the United States and that a certain number be placed at the disposal of this society for presentation to institutions and societies of learning, including those with which Franklin was connected.

That the following guests be invited to participate in the celebration: the president of the United States; the vice-president and other high officers of state; the governors of the states of which Franklin was the colonial agent; foreign ambassadors accredited to the United States; a special representative from the republic of France; special representatives from societies and institutions with which Franklin was connected; representatives from home and foreign scientific societies and institutions of learning with which the American Philosophical Society is in correspondence.

The report of the committee was approved and the committee continued with instructions to carry out the plan as proposed, with authority to make such modifications as may seem to it desirable, to fix the time and place for the celebration and with full power to do all things necessary or desirable for the appropriate celebration of the anniversary.

At the annual election the following persons were chosen members:

Maurice Bloomfield, Ph.D., LL.D., Baltimore.

Professor of Sanskrit and comparative philology at the Johns Hopkins University; editor of the 'Kashmirian Atharra-Veda,' 3 vols., 1901; translator of the Hymns of the Atharra-Veda in Max Müller's edition of the 'Sacred Books of the East' (Vol. 42); author of numerous papers in the *Journal of the American Oriental Society*, etc.

Henry Pickering Bowditch, M.D., LL.D. (Edin.), Sc.D. (Cantab.), Jamaica Plains, Mass.

Professor of physiology in Harvard University; one of the authors of the 'American Text-Book of Physiology'; author of numerous important contributions to physiology.

Edward Potts Cheyney, Philadelphia.

Professor of history at the University of Pennsylvania; author of 'Introduction to the Industrial

and Social History of England' (1901), 'Social Changes in England in the Sixteenth Century as Reflected in Contemporary Literature' (1895), 'Short History of England' (in press), etc.

Russell H. Chittenden, Ph.D., New Haven.

Professor of physiological chemistry in Yale University; director of Sheffield Scientific School, Yale; president of American Society of Naturalists, 1893; president of American Physiological Society, 1895; author of 'Studies in Physiological Chemistry,' 4 vols., and of many papers on physiological subjects in American and foreign journals; associate editor of the *American Journal of Physiology* and of *Journal of Experimental Medicine.*

Frank Wigglesworth Clarke, S.B., Sc.D., Washington.

Chief chemist in the United States Geological Survey; formerly professor of chemistry in Cornell University and in the University of Cincinnati; author of 'Elements of Chemistry,' 'Weights, Measures and Money of all Nations'; past president of American Chemical Society, chairman of International Committee on Atomic Weights.

John Chalmers Da Costa, M.D., Philadelphia.

Professor of surgery in Jefferson Medical College; author of a text-book on 'Modern Surgery' and of many contributions to medical periodical literature.

Kuno Francke, Ph.D., Cambridge, Mass.

Professor of German literature at Harvard University; author of 'Social Forces in German Literature' and of numerous monographs; curator of the Harvard Germanic Museum.

Adolphus W. Greely, U. S. A., Washington.

Brigadier-General and chief signal officer of the United States Army; distinguished meteorologist and Arctic explorer; gold medallist of the Royal Geographical Society and of the French Geographical Society; author of 'Chronological List of Auroras,' 'Diurnal Fluctuations of Barometric Pressure,' 'Report of the Proceedings of the United States Expedition to Lady Franklin Bay, Grinnell Land,' 2 vols., 4to, 1888; 'Three Years of Arctic Service,' 'American Weather,' 'Climatology of Arid Region,' etc.

Preston Albert Lambert, Bethlehem, Pa.

Assistant professor of mathematics at Lehigh University; author of text-book on 'Analytic Geometry and Differential and Integral Calculus.'

Edgar Odell Lovett, Ph.D., LL.D., Princeton.

Professor of mathematics in Princeton University; member of the American Mathematical Society, Société Mathématique de France, London Mathematical Society, Mathematical Society of Edinburgh, Circolo Matematico di Palermo; author of numerous important papers on mathematical and astronomical subjects.

Edward Leamington Nichols, Ph.D., Ithaca.

Professor of physics at Cornell University; editor of the *Physical Review;* author of 'The Galvanometer' (1894), 'A Laboratory Manual of Physics and Applied Electricity,' 2 vols., 'The Elements of Physics,' 3 vols., and of numerous papers on experimental physics.

Hon. Theodore Roosevelt, Washington.

President of the United States.

Samuel W. Stratton, Washington.

Director of the National Bureau of Standards, late professor of physics in the University of Chicago.

Harvey W. Wiley, A.M., M.D., LL.D., Washington.

Chief of the Bureau of Chemistry, United States Department of Agriculture; author of a 'Text-Book on Agricultural Chemistry' and of numerous papers on agricultural chemistry; past president of the American Chemical Society and of the American Society of Agricultural Chemists.

Foreign residents:

Friedrich Delitzsch, Ph.D. (Leipzig), Berlin.

Professor of Assyriology in the University of Berlin; director of the Babylonian section of the Berlin museum; author of 'Assyrisches Wörterbuch,' 'Assyrische Grammatik,' 'Wo Lag das Paradies?' and numerous other works.

Sir Richard C. Jebb, LL.D., D.C.L., Cambridge.

Regius professor of Greek at Cambridge; author of numerous contributions to classical literature, including 'Sophocles, with Critical Notes, Commentary and Translation,' 2 vols., 1883–96; president of London Hellenic Society.

Ernest Rutherford, F.R.S., Montreal.

Macdonald professor of physics at McGill University; author of numerous papers on various branches of physical science and particularly on the subject of radio-activity, and on the ionization of gases by Röntgen and Becquerel rays.

Jakob Heinrich Van't Hoff, Berlin.

Professor of chemistry in the University of Berlin; author of some epoch-making discoveries in physical chemistry and of numerous contributions to chemical literature, including 'Lectures on Theoretical and Physical Chemistry,' 'Studies in Chemical Dynamics,' 'Chemistry in Space,' etc.

Wilhelm Waldeyer, Berlin.

Rector magnificus of the university and professor of anatomy at Berlin; eminent anatomist and author of numerous contributions to the literature of anatomy.

*Afternoon Session—2 o'clock.*

President Smith in the chair.

*A System of Passenger Car Ventilation:* Dr. Charles B. Dudley, Altoona, Pa.

During the last ten years there has been developed by the various experts of the Pennsylvania Railroad Company, a system of passenger car ventilation, which bids fair to prove a reasonably successful solution of this difficult problem. The system in brief consists in taking air from the outside in through hoods covered with wire gauze to exclude coarse cinders, situated at diagonally opposite corners of the car, on what is known as the lower deck, near the top of the car. Thence the air passes through a vertical down-take through the floor to a space underneath the floor, which is bounded by the outside sill, the floor, the first intermediate sill, and the false bottom. This space underneath the floor, reaches the whole length of the car. From this space the air passes up through the floor, by means of slots in the floor, into the heater boxes where the air is warmed by the radiators. From the heater boxes the air passes out through a proper tubular aperture, situated underneath each seat, into the main aisle, from which point it distributes itself throughout the car, and finally passes out of the car through ventilators situated along the center line of the upper deck, which ventilators are so arranged that when the car is in motion, or the wind blows across the top of the car, they produce a suction on the car, helping to exhaust the foul air.

The amount of air taken through the car by the system when all the ventilators are open is about 60,000 cubic feet per hour, or approximately 1,000 cubic feet of fresh air per passenger. A passenger coach embraces about 4,000 cubic feet of space, so that the air in the car is changed fifteen times an hour.

The experiments indicating the amount of air as above were made with cars in motion in a train, and with heat in the cars. The control of the system is in the ventilators in the upper deck. By closing the valves in these ventilators, it is possible to diminish the amount of air under the same conditions as above to about half or a little more. This diminution applies during extreme cold weather, or when there are only a few passengers in the car. When the car is standing still, and there is heat in the car, nearly half the amount of fresh air that is obtained under full movement still passes through the car. When the car stands still, with no heat in the car and no lamps lighted, the amount of ventilation is still more diminished. Thus far no serious difficulties have been experienced in keeping the cars warm, even in the most severe weather, with the system of heating for which the ventilating system was devised, and the results have proved so satisfactory that the system has now been applied to about 800 passenger coaches on the Pennsylvania system east of Pittsburgh and Erie, and to nearly 200 coaches on the Pennsylvania lines west of Pittsburgh; also to some few cars on other railroads. It has not yet been applied to Pullman cars.

*Atmospheric Nucleation:* Professor Carl Barus, Providence, R. I.

There is considerable probability that material emanations from the sun enter

our atmosphere, and is believed that not only auroras, magnetic storms and other electrical phenomena are attributable to this cause, but that ordinary meteorological conditions, like the changes of the barometer, are thus powerfully influenced. The speaker has for several years been endeavoring to obtain direct evidence of this effect and he described the methods used for counting the number of active foreign particles (ions or nuclei) in the atmosphere.

The first method is based on the observed size of those brilliant optical phenomena called coronas and sometimes seen around the moon. These coronas are artificially produced in a vessel containing a sample of the air to be examined, and the number of particles may be computed from the coronal diameter. Lantern slides are shown giving results as obtained at Brown University, in Providence.

In a second method the speaker determined the number of nuclei from photographs of the fog particles condensed on the nuclei. Lantern slides showing fog particles even less than .0003 cm. in diameter were exhibited. The photography of these small water globules, each a perfect sphere, has never before been accomplished and the difficulties encountered were fully pointed out.

*On the Collecting of Meteorites:* DR. ARISTIDES BREZINA, Vienna. (Read by Dr. Amos P. Brown.)

Matter of any kind should be collected, not only systematically but also synoptically, without starting from all points of view from which the matter in question may be arranged.

The author illustrates this thesis on a synoptical collection of meteorites formed since 1896 which consists of seven groups.

I. *Betyl Coins.*—The ancients supposed the stars to be domiciles of gods; falling-stars and falling meteorites signified the descending of a god or the sending of its image to earth.

These envoys were received with divine honors, embalmed and draped and worshipped in temples built for them.

These betyls are in the main:

The omphalos of Delphi, a black stone represented on coins of Eleuthernai, Makedonia, Myrina, Nakrasa, Neapolis, Parthia (the first six Arsacides), Rome, Syria (ten Seleucid Rings from Antiochus Soter to Alexander Bala).

The black conical stone fallen at Emisa and called El Gabal, the sun. Represented on coins of Emisa and Rome.

Zeus Kataibates on coins of Kyrrhos.

The conical stone fallen at Kypros and worshipped as image of Aphrodite Paphia.

The image of Artemis Ephesia fallen at Ephesos; represented on coins of Aizanis, Ankyra, Ephesos, Eumeneia, Nakrasa, Philadelphia, Provincia Asia, Rome, Tabai and Tiberiopolis.

The stone of Astarte on coins of Sidon and Tyros.

The pyramids of Apollon on coins of Ambrakia, Apollonia, Megara and Myrina.

The stones of Zeus Dolichenos or Herakles Sandan; coins of Tarsos.

Zeus Katios, a conical stone suspended by a chain; coins of Seleukeia.

Conical or quadratic stones on coins of Mallos or Rhosos, Perga and Synnada.

The conical stone of Aphrodite Urania on coins of Makedonia (Tetradrachms of Alexander the Great) and Uranopolis.

The simulacres of Artemis Anaïtis, Artemis Leukophrys, Artemis Pergaia, Astarte, Hera, Persephone, etc.

Coins representing related celestial bodies (comets).

In all, 250 coins from 60 towns or regions representing 22 gods.

II. *Historical meteorites* which were worshipped by primitive nations or which

formed standards in the development of meteoric science; prehistoric meteorites from tumuli or mounds, the oldest meteorite of known fall (Ensisheim, 16 November, 1492). Iron fallen with the zielid shower at Mazapil, meteor dust and terrestrial dust, etc., nineteen specimens.

III. Thirteen specimens illustrating *scattering of meteorites,* among them the stones of Lerici, Italy and Pultusk, Russia, fallen simultaneously (30 January, 1868, 7 hrs.) on the flying-line of the Pultusk-shower.

IV. One hundred and twenty-five specimens illustrating *melting and fusion, scorification, faulting and separating;* different kinds of crust, whole orientated individuals, metallic and molten veins, harnesses and fissures, products of heating, alteration-zones, wallborders bent and unbent, etc.

V. Seventy-two specimens illustrating *weathering and formation of new constituents;* different processes of oxidizing, natural dividing and uncovering of more resistant minerals, changing in limonite and nickel-minerals, etc.

VI. One hundred and thirty-six specimens illustrating *constituents of meteorites,* among them phosphor, diamond, graphite, crystals of nickel iron, cohenite, schreibersite, troilite, daubréetite, chromite, olivine, anortite, kosmochlore, enstatite, chondres of various kinds, etc.

VII. The systematic collection representing 9 classes in 58 groups and 280 localities of meteorites (irons and stones).

*On the Occurrence of Artifacts Beneath a Deposit of Clay:* Dr. Charles Conrad Abbott, Trenton, N. J.

*On the Breeding Habits of the Spade Foot Toad* (*Scaphiopus Solitarius*)*:* Dr. Charles Conrad Abbott, Trenton, N. J.

*Doliolum and Salpa:* Professor William Keith Brooks, Baltimore.

*The Organization of the Germ Cells and its Bearings on Evolution:* Professor Edwin Grant Conklin, Philadelphia.

Specific substances destined to give rise in the course of development to specific parts or organs are present in the unsegmented eggs of ascidians and snails and presumably also of other animals. These substances become localized at the time of the maturation and fertilization of the egg by an active flowing of the cell substances. Modifications of this localization, produced by modifications in the direction of the protoplasmic flow, do occur and lead to profound modifications of the adult (*e. g.,* dextral and sinistral forms). It only remains to extend by hypothesis similar modifications of egg localization to the eggs of different phyla in order to throw light upon one of the most difficult problems in evolution, viz., the origin of certain phyla, such as the vertebrates.

*Summary of the Recent Movements to Teach Agriculture in the Schools:* Professor L. H. Bailey, Ithaca, N. Y. Read by title.

*The Origin and Nature of Color in Plants:* Professor Henry Kraemer, Philadelphia.

Colors in plants may be considered to be due to definite constituents which either themselves are colored or produce colors when acted upon by other substances. These substances are found in all parts of the plant, and in all of the cells excepting meristematic or dividing cells. They may be divided into two well-differentiated classes, namely, (1) those which are associated with the organized bodies in the cell, and (2) those which occur in the cell-sap or liquid of the cell.

The earliest color to appear in the developing plant is a yellow, and this is due to a principle which the author calls *etiophyl* to avoid confusion. This is associated

with a protoplasmic body termed by the author an *etioplast.* These bodies are more or less spherical or polygonal and are about one thousandth of a millimeter in diameter. They occur in the cells beneath the epidermal layer, and later, under the influence of light, appear to be transformed into chloroplasts, the bodies giving the color to the leaves and other green parts of the plant. Under certain conditions the chloroplastid may likewise undergo a transformation into a yellow orange-colored body, known as a chromoplast, the pigment associated with it being called by the author, chromophyl. These plastid pigments are distinguished from all other plant colors by their solubility in such solvents as benzol, ether, volatile oils, etc.

During the course of metabolism the plant cell manufactures other color substances which are not combined with the protoplasm or other organized bodies, but which are contained in the cell sap or liquid of the cell. These substances, unlike the plastid colors, are insoluble in the abovenamed solvents, but soluble in water and alcohol, which affords a means of separating them from the plastid colors. Most of the colors of flowers excepting yellow and orange are due to substances of this class. The colors of many fruits, as apple, cranberry, strawberry, blackberry, grape, etc.; of red and brown seaweeds; of vegetables, as turnip, radish, rhubarb, purple cabbage, etc., and also of autumn leaves belong to this class, that is, are cell-sap colors. The author's experiments tend to show that the color of autumn leaves, as beech, maple, oak, etc., are in the nature of cell-sap colors, rather than due to a compound associated with the plastids as has been supposed heretofore. His researches, furthermore, tend to show that there is considerable difference in the cell-sap colors, or dyes, from various plants, and while they are all more or less constant in their behavior toward sodium phosphate, yet their behavior with a dozen or more reagents shows that no two of them are precisely alike, or if they are alike are associated with substances which influence their behavior toward reagents. As illustrating this point it may be mentioned that while the color of red rose closely resembles that of the red portion of the turnip in many respects, it differs from it in that an alcoholic solution of red rose becomes cloudy or fluorescent on the addition of water and the color is intensified on the addition of salicylic acid. It is also interesting to note that in the kernel of black Mexican sweet corn contiguous cells may show different colors, as reddish, bluish-green and purplish, this being due to the nature of the other substances associated with the dye in the cell sap.

The author is inclined to look upon the chromoplastids of both flowers and fruits as having the special function of manufacturing and storing nitrogenous food materials, which are almost invariably contained in them, for the use of the germinating plant. He further considers the cell-sap colors, like other organized cell-contents, to be incidental to physiological activity and of secondary importance in the attraction of insects for the fertilization of the flower and dispersal of the seed.

SATURDAY, APRIL 9.

*Morning Session—10 o'clock.*

President Smith in the chair.

*The Establishment of Game Refuges in the United States Forest Reserves:* MR. ALDEN SAMPSON, Haverford, Pa.

The author spent six months in the forest reserves of California and Washington, during the summer of 1903, as game preserve expert, sent out by the United States Biological Survey to study the problem of game refuges, and to select tracts

suitable for the purpose when the time for creating them shall come.

The general plan was outlined in what is known as the 'Perkins Bill,' which was passed by the United States senate in the spring of 1903, but did not come to a vote in the house. By its provisions the president would have power to designate certain tracts in the forest reserves where there may be no hunting; which shall serve as refuges and breeding grounds for wild animals. By this the extermination of the larger mammals will be prevented, and at the same time the hunting in the vicinity of these refuges will be maintained by the overflow of game, as is the case in the vicinity of the Yellowstone National Park. This is a type, on a large scale, of what it is desired to establish elsewhere.

These reserves will be mainly for the protection of deer which are to be found widely distributed. It is the intention to prevent the recurrence of that which happened in the case of the buffalo. Of the millions which once ranged over the plains, less than 1,000 now remain. It is hoped that their number will be increased. There remain two large herds of elk, one of about 16,000 in the Yellowstone Park, another of probably 3,000 in the Olympic Mountains in Washington; a band of 100 in California, besides which there are various small bands in different states. The antelope are nearly exterminated, as are the mountain sheep, but all of these, as well as the Rocky Mountain goat and various small animals and birds, will be preserved in the refuges when created. No fishing will be permitted within these tracts, so that the trout may breed unmolested. It is hoped that the control of the refuges will be placed under the Bureau of Forestry, with competent rangers to patrol them.

The paper read on this occasion set forth the various reasons which justify and demand the creation of game refuges in all parts of the country.

*The Use of the Relative Pronouns in Standard English Writers:* Professor Waterman T. Hewitt, Ithaca, N. Y.

The purpose of this paper is to present briefly the historical development and use of the relative pronouns in English since the time of Wycliffe. Mention is made of some of the best known English writers whose style is colored by certain special features in their use of subordinate sentences introduced by the relative pronouns. Then follows a discussion on the use of the relatives *that* and *which* with examination of their use in the Tyndale and King James's version of the Bible. Also in the Lord's Prayer as shown in translations from 1130 A. D. to the present time. Lastly the use of these pronouns in proverbs and children's rhymes is considered.

*The Effect of the American Revolution Upon the English Colonial System:* Mr. Sydney George Fisher, Philadelphia.

It is commonly supposed that England changed her methods of colonial government immediately after our revolution and learned to retain her colonies by the affectionate method without military force or coercion. This, however, is a great mistake. England became much more severe in her methods of colonial control after our revolution, and continued to carry out all the principles and policies against which we had rebelled.

England, after our revolution, governed Canada with the utmost severity, as Mr. Bourinot has described in his excellent books on Canadian history. Canada was allowed no local government, no county or township officers, and carefully prevented from imitating the New England town meetings, which were supposed by England to have been an important cause of

the American revolution. Our revolution caused England to tighten, not to loosen, her grip on her dependencies.

It was not until 1837 that the Canadian rebellion wrought a change in British colonial administration. Just at that time the whig party and free trade ideas were gaining a great ascendency in England, and as a result of these ideas and the Canadian outbreak in 1837 Great Britain gradually began to grant what is called 'responsible government' to the Canadian and Australian provinces. So that it is to the Canadian rebellion of 1837 rather than to our revolution that the present rather liberal and easy governments of Canada and Australia owe their existence. This change appears to have been an immense relief to the people of the Canadian and Australian provinces. The Canadians, after over seventy-five years of British rule, numbered, at the time of the rebellion of 1837, only 1,500,000, but in the succeeding sixty years of responsible government they have increased to 6,000,000. The Australian colonists have also gained a similar increase.

*The Hedonic Postulate:* Professor Lindley M. Keasbey, Bryn Mawr, Pa.

*Results of the American Ethnographical Survey:* Professor Marion D. Learned, Philadelphia.

In the summer of 1902 the American Ethnographical Survey was organized to investigate the actual relations of the various race elements in our American population and their importance in American civilization. A sum of money was collected by the German American Alliance and the German American Historical Society, and a beginning made in Pennsylvania by an examination of the Conestoga region. The Conestoga expedition was composed of Professor M. D. Learned, director; Dr. G. D. Luetscher, Dr. Charles R. Miller, Dr. J. A. Bole, Mr. C. F. Brede, Mr. E. M. Fogel. Special attention was given to tracing the German settlements from 1709 on, and their relations to their English, Scotch-Irish and Welsh neighbors. A part of the expedition made a careful study of the community settlement of the Rappists, now located at Economy, Pa. A large amount of material was collected along the lines of early settlements and migrations, trades, industries and their effects upon the geographical distribution of the population, religion, education, politics, manners, customs, superstition, dress, language, literature and architecture. This material has been published in part in the following papers in the German American Annals:

1. 'The American Ethnographical Survey, Preliminary Report of the Conestoga Expedition,' by the director.
2. 'Benjamin Herr's Journal, 1830,' by the director.
3. 'An Old German Midwife's Record, 1791–1815,' by the director with C. F. Brede.
4. 'Industries of York and Lancaster Counties,' by G. D. Leutscher.

The following matter is in press and being prepared for the press:

1. 'History of the Rappist Settlement,' by J. A. Bole (in press).
2. 'The Official Report of the Survey.'
3. 'A Series of Race Maps, Showing the Distribution of the Race Elements at Different Periods.'
4. 'A Dialect Map, with Special Reference to the German Dialects.'
5. 'The Architectural Survivals.'
6. 'Studies in Literature, Language and Biography of the Region.'

*Regulation of Color-Signals in Marine and Naval Service:* Dr. Charles A. Oliver, Philadelphia. Read by title.

The social features of the meeting were especially pleasant. In addition to the public reception on Thursday evening the

luncheons which were served in the hall of the society on Thursday and Friday afforded many opportunities for meeting old friends and making new ones. The culminating social event was the dinner given by the resident to the non-resident members at the Hotel Bellevue on Friday evening. On this occasion addresses were made by the president of the society, Professor Edgar F. Smith, of Philadelphia; Hon. George F. Baer, of Philadelphia; Professor Simon Newcomb, of Washington; Professor Edward S. Morse, of Salem; Professor George F. Barker, of Philadelphia; Professor William B. Scott, of Princeton; Professor Josiah H. Penniman, of Philadelphia; Mr. Henry LaBarre Jayne, treasurer of the society, and Dr. I. Minis Hays, one of the secretaries.

## SCIENTIFIC BOOKS.

*Vorlesungen über Experimentalphysik.* Von August Kundt. Friedrich Vieweg und Sohn. 1903.

Few courses of lectures on general physics have been so well known as those of Professor Kundt at the University of Berlin. They were renowned throughout the world of students for their clearness of exposition, the enthusiasm both of lecturer and of listener, and the wonderful manner in which the facts of physics were illustrated by lecture-room experiments. Professor Kundt died in May, 1894, and steps were immediately taken to present to the world, in the form of a text-book of physics, his famous course of lectures. This has just been done, and the volume at hand from the press of Friedrich Vieweg is one of 851 pages illustrated with more than 500 figures in the text. There is an excellent portrait of Kundt, and a short but appreciative biography.

The lectures which are here reprinted are those given in the winter and summer semesters of 1888–9, which were noted by one of his students and afterwards were revised and worked over by Kundt himself. They are now published under the editorial supervision of Karl Scheel, who very wisely has made no attempt to add chapters, or even notes, with the idea of making the lectures describe the facts of physics which have come into prominence since the death of Kundt.

The course of lectures in general physics which has been given at the University of Berlin by a long line of distinguished men, including Helmholtz, Kundt and Kohlrausch, is one designed specially for students of medicine, or those who wish to become acquainted with the phenomena of physics, but who do not necessarily intend to follow more advanced work in physics, and who do not regard this course as of fundamental importance. This fact necessarily has a most important bearing on the character of the lectures given. In the majority of cases in American universities and colleges physics is now taught largely owing to its educational value, in the sense that in order for a student to follow the course intelligently he must exercise certain mental qualities which are of the utmost importance in any scheme of education. The character of text-book, therefore, which would best represent the needs of these two kinds of classes is quite different; and the main interest in this book of lectures of Kundt centers in his mode of presentation of the various branches of physics in order to meet the demands made by his conditions.

One can not do better in reviewing the book than to give a few details in regard to the number of lectures assigned to various subjects, and to note their order of arrangement. In all there are 150 lectures: 39 in mechanics and properties of matter, 17 in acoustics, 31 in heat (including five on the kinetic theory of gases), 43 in electricity and magnetism and 20 in light. This division is most interesting and, in some respects, surprising. In treating the subject of mechanics there are one or two introductory chapters followed by one in which are introduced the ideas of mass, force, work and energy; then the subjects of equilibrium and machines are introduced; gravitation and various pendulum problems are next discussed, and then the lectures return to the questions of centrifugal force and moments of inertia. There follow six lectures on liquids, seven on gases, three on solids and six on the bound-

ary phenomena between two different kinds of matter. It will be seen at once that the order of presentation adopted by Kundt is one which lends itself most easily to simplicity of treatment, and is not at all concerned with the logical development of the subjects. Throughout the whole book all mathematical points are avoided and the utmost required is a most elementary knowledge of geometry. There is no discussion whatever as to our mode of understanding what is meant by mass or force, and no attempt is made to show the logical connection between various subjects. As one reads the lectures one is struck with their clearness of thought, the beauty and vigor of expression, but above all with the fact that from the standpoint of interest to the class it would be impossible to present the subject in a better manner. All difficulties seem to vanish and the student is led from one phenomenon to another, and back again to more complex illustrations of the former, until all the essential facts of the subject are brought before him. If the treatment of the subjects of electricity and magnetism is analyzed, it is seen to be of the same general character as that of mechanics. There are a few chapters on the subject of electrostatic phenomena followed by a discussion of magnetism; then the ideas of electrostatic potential and capacity are introduced, and this leads to a discussion of electric currents. Special emphasis is laid throughout the whole book upon the description of instruments for measurement and for ordinary laboratory use, and the question of the development of ideas is in many cases subordinated to this. A marked illustration is afforded by the fact that, since an induction coil is ordinarily used in producing electric currents through gases, therefore the whole subject of induced currents is taken up before the chapter on conduction through gases. An illustration of the fact that the main object of these lectures is to describe physical phenomena and not explain them is shown by noting that there is no discussion whatever as to the energy of electrostatic or electromagnetic fields or of the reasons underlying electric and magnetic attraction and repulsion, and yet interference with convergent polarized light, quartz compensators, systems of multiplex telegraphy, etc., are discussed in full.

The publishers of this volume in their preliminary announcement express the belief that it will be useful to those who are following courses in physics as a text-book to accompany their lectures, and also to the scholar in general as an introduction to physical phenomena. They say, moreover, that every one who is familiar with the teaching of physics will receive, as he reads the book, continual pleasure from the elegant and original method of presentation of facts already known to him. These statements of the publishers fall short of the whole truth. There is no book at the present time, so far as known to the reviewer, which presents the subject of physics in such an attractive manner, and a translation of it in English would be of the greatest use in many colleges and schools. To the teacher of physics the great interest of the book lies in the fact that one has here an opportunity of seeing how a great master in the art of lecturing prepared his course; and, further, because he can not fail to learn many ways by which the subject may be made more interesting to his class and at the same time less difficult.

J. S. AMES.

THE JOHNS HOPKINS UNIVERSITY.

*Disinfection and the Preservation of Food.* By SAMUEL RIDEAL, D.Sc. New York, John Wiley and Sons. 8 vols., 504 pages, illustrated. $4.00.

THIS valuable work gives in convenient form the latest information respecting disinfection and the preservation of food. The greater part of the work is devoted to the subject of disinfection, and is so presented as to make it possible not only to carry this important process on on a large scale for public purposes, but also in a small way in private families. The various substances used for disinfection are described and their methods of application explained.

The different methods are grouped under the heads 'Mechanical Disinfection,' 'Sterilization by Heat' and 'Chemical Disinfectants.' Both sterilization by heat and the use of chemical disinfectants are also employed in the

preservation of food. Chemical disinfectants are described under the heads of 'Metallic Salts,' 'Organic Substances' and 'Compounds Related to the Alcohols.'

Methods of disinfection are described as related to towns and municipalities and as personal and internal disinfection. The chapter on the preservation of food is only a small part of the work and is not nearly so valuable as the part devoted to disinfection pure and simple. A résumé of legal statutes and regulations is also given and a short and necessarily brief account is given of the methods of analysis.

Of great interest is the discussion of those substances used both as disinfectants and as food preservatives. Many of these are described as non-poisonous, in such a way as to mislead the careless reader.

A careful reading of the article on fluorides would not warrant the apparent recommendation of it as a substance suitable for addition to food products.

Inasmuch as acetate of alumina has lately been used to a very large extent in sausages imported into this country, it is interesting to read, on page 175, the statement referring to this substance: 'It would doubtless be useful for surgical dressings but is unnecessary and unsafe as a disinfectant.'

In general it may be assumed that substances which are valuable for surgical dressings are not as a rule proper substances to be added to foods.

The salts of copper and zinc belong also to this class of bodies, and while their use as disinfectants is praiseworthy, their presence in food products is at least suspicious.

Other well-known substances belonging to both classes are salicylic and benzoic acids and their salts, sulphurous acid and its salts, and formaldehyde.

In regard to the preservation of food by these reagents the general tendency of Rideal's work is to discourage their use, and this tendency must, it seems to me, be commended by all thoughtful students of hygiene and nutrition. In spite of this general tendency, however, the department committee of the English government, while prohibiting absolutely the use of formaldehyde or preparations thereof in foods, recommends that salicylic acid may be used in quantities not greater than one grain per pound, except in milk, from which all preservatives of every kind are excluded. Cream and butter, however, are allowed to carry boric acid or borax; in the case of the former, in quantities not to exceed .25 per cent. of boric acid or its equivalent in borax; in the case of the latter, not to exceed .5 per cent. of boric acid or its equivalent in borax. In the case of foods intended for infants and invalids, however, all preservatives are to be excluded. At the International Congress of Hygiene at Brussels, 1903, resolutions were passed in favor of the total abolition of preservatives in all kinds of foods. This, however, as is seen, includes salt, sugar, wood smoke, etc., which have been in use from time immemorial and hence such a recommendation is too drastic (page 423).

The summary of facts respecting food preservation by chemicals is a very valuable part of this excellent work.

H. W. Wiley.

## SCIENTIFIC JOURNALS AND ARTICLES.

The May number of *The American Journal of Science* contains the following articles: 'Recent Changes in the Elevation of Land and Sea in the Vicinity of New York City,' by G. W. Tuttle; 'Geology of Brome Mountain, one of the Monteregian Hills,' by J. A. Dresser, 'Crystallization of Molybdenite,' by A. J. Moses; 'Behavior of Typical Hydrous Chlorides when Heated in Hydrogen Chloride,' by F. A. Gooch and F. M. McClenahan; '*Stegomus Longipes*, a New Reptile from the Triassic Sandstones of the Connecticut Valley,' by B. K. Emerson and F. B. Loomis; 'Note on the Probable Footprints of *Stegomus Longipes*,' by R. S. Lull; 'Canyon City Meteorite from Trinity County, California,' by H. A. Ward; 'Two Microscopic-Petrographical Methods,' by F. E. Wright; 'Denucleating Effect of Rotation in Case of Air Stored over Water,' by C. Barus and A. E. Watson.

The May number (volume 10, number 8) of the *Bulletin of the American Mathematical Society* contains the following articles: 'Report of the February Meeting of the American Mathematical Society,' by Professor F. N. Cole; 'Report on the Requirements for the Master's Degree,' by the Committee of the Chicago Section; 'On the Subgroups of Order a Power of $p$ in the Linear Homogeneous and Fractional Groups in the $GF[p^n]$,' by Professor L. E. Dickson; 'The Exterior and Interior of a Plane Curve,' by Dr. G. A. Bliss; 'Ricatti Isothermal Systems—a Correction,' by Dr. Edward Kasner; Shorter Notices; Notes; New Publications.

According to the annual announcement of the Marine Biological Laboratory at Wood's Hole, the *Journal of Morphology*, the publication of which was interrupted in 1901, at the conclusion of the seventeenth volume, is to be immediately resumed, and will be open for larger papers in animal morphology, requiring, as a rule, extensive illustration in lithographic plates. A *Journal of Animal Biology* is also to be undertaken in the interest of investigations upon living animals, dealing especially with the problems of evolution as presented in the phenomena of heredity, variation, hybridization, etc., and requiring experimental methods and methodical observation.

## *SOCIETIES AND ACADEMIES.*

### THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 152d meeting was held February 24, 1904.

Dr. Arthur L. Day presented a paper entitled 'The Study of Minerals in the Laboratory.' Dr. Day drew attention to the relation of some problems of physics to geology and pointed out the lines of investigation which had been undertaken by the Physical Laboratory of the United States Geological Survey. His paper was intended as an introduction to a summary of the results of certain investigations, an abstract of which will appear below.

This was followed by a discussion of the oil fields of Alaska, by Dr. George C. Martin. Indications of petroleum have been found at three distinct localities on the Pacific Coast of Alaska and have been reported from several others. The Controller Bay field lies adjacent to the coast, about twenty miles east of the Copper River delta. In this field one well has been drilled which struck oil and several others were being put down at the time of Dr. Martin's visit. The rocks, consisting of shales and sandstones, are closely folded and are probably of Tertiary age, and are overlain by coal-bearing horizons which are also Tertiary. The structure, as far as could be determined, is complex.

The second locality lies on the west shore of Cook Inlet, at Enochkin Bay. In this locality the seepages indicate the presence of petroleum, though the wells drilled thus far have not yielded any gushers. The oil-bearing rocks are of Jurassic age and are thrown up into broad, open flats.

One hundred miles to the southwest is Cold Bay, where a similar occurrence of petroleum seepages has been found. The geologic structure and rocks seem to be identical with those of Enochkin Bay. An account of these oil fields has been published by Dr. Martin in Bulletin 225, U. S. Geological Survey, pp. 362–385.

The 153d meeting was held March 9 and the first paper was entitled 'Extra Morainic Pebbles in Western Pennsylvania,' by Mr. Lester H. Woolsey. Mr. Woolsey said that glacial pebbles, granites, diabases, etc., of probably Wisconsin or Iowan age, have been found in 950-foot terraces (supposedly Kansan) along Raccoon Creek in Beaver and Washington counties as far south as Burgettstown on the Panhandle Railway. Similar pebbles were found up to 1,100 feet elsewhere in Beaver County. This is some evidence of a general flooding of this region in post-Kansan time.

Mr. F. H. Knowlton then gave a paper on the 'Fossil Floras of the Yukon.' Up to about 1900 the known fossil flora of Alaska numbered about 110 species, all of which had come from the coast region from Sitka to Cape Lisburne. With the exception of the Cape Lisburne forms, which were regarded as of Jurasso-Cretaceous age, practically all those known were Tertiary in age. The discovery

of gold in the interior incited exploration, and soon small collections of plants were brought in, mainly from upper rocks of the Yukon. As these agreed in Tertiary age with those previously known from the coast region, it came to be accepted that only Tertiary plants occurred throughout this vast area. The U. S. Geological Survey desired to establish a type section, and in 1902 Mr. A. J. Collier was delegated to make a trip down the Yukon, studying the stratigraphy and collecting fossils from as many points as possible. When the plants were studied it was found that those from above Rampart were Tertiary (so-called Arctic Miocene), while below this point a very different condition was found. Near Nahoclatilten Mr. Collier obtained collections which appeared to be mixed, that is, a part of the material seemed to be Tertiary and the remainder Middle or Lower Cretaceous. Undoubted Upper Cretaceous plants were obtained from a number of other localities, especially in the vicinity of Nulato, but so much interest attached to the Nahoclatilten localities that in 1903 Dr. Arthur Hollick was commissioned to duplicate Mr. Collier's trip. From the combination of the two collections it is possible to decide with certainty that all points above Rampart are Tertiary, while below the plants indicate that the age is either undoubted Cretaceous or doubtful Tertiary. The Cretaceous plants include cycads of several genera, conifers and many dicotyledons, the combination resembling mostly the Middle and Upper Cretaceous flora of Bohemia.

Mr. Marius R. Campbell then discussed 'Glacial Erosion in Western New York,' devoting special attention to the origin of the Finger Lakes. Mr. Campbell's paper is soon to appear as a publication of the Geological Society of America.

The 154th meeting, held March 23, was devoted to a communication by Dr. Arthur L. Day, entitled 'The Study of Minerals in the Laboratory.' The following brief abstract contains the more important conclusions.

The paper is a summary of an extended experimental research by Dr. Day and Dr. E. T. Allen upon a series of artificial feldspars corresponding to albite (Ab) and anorthite (An) and the following plagioclases: $Ab_1An_5$, $Ab_1An_2$, $Ab_1An_1$, $Ab_2An_1$, $Ab_3An_1$ and $Ab_4An_1$. These were prepared with great care from the purest chemicals, and, with the exception of albite, which could not be crystallized on account of its extreme viscosity, were fully identified microscopically.

Melting-point determinations were obtained, beginning with anorthite and continuing down the series as far as $Ab_3An_1$. The viscosity was found to increase enormously toward the albite end of the series and appeared to veil the melting point completely below $Ab_3An_1$. In a specimen of natural albite (Mitchell County, N. C.) the viscosity of the glass during melting was found to be of the same order of magnitude as that of the crystallized portion, and crystals of microscopic size sustained a slow heating to a temperature of 150° above where melting began, and preserved their original orientation. It was also shown that in viscous liquids, capable of considerable undercooling, the solidifying point did not coincide with the melting point or bear any necessary relation to it.

The chemical purity of the artificial feldspars enabled very accurate determinations of the specific gravity to be made of both the vitreous and the crystalline form.

The following conclusions were offered as tending to show that the soda-lime feldspars form an isomorphous series and not a eutectic mixture:

1. In $Ab_1An_5$ the spherulites and the glass matrix were analyzed separately and proved to be identical in composition. In $Ab_1An_2$ a portion was crystallized rapidly and the matrix crystallized very slowly in a subsequent heating. The two sets of crystals, although very different in size, proved to be identical in composition.

If the relation had been that of a eutectic mixture, the component in excess must have crystallized out first.

2. The curve of melting points of the pure (artificial) feldspars of the series is a straight line for some two thirds of the distance from anorthite to albite (as far as it could be established). There is no reason to suspect a discontinuity in the lower portion of the curve.

3. The fact that natural albite (Mitchell Co., N. C., Amelia Co., Va.) is too low in melting point and too high in specific gravity to fall into line with the observations upon the pure feldspars is readily explained by the impurities established by the chemical analyses.

4. The curve of specific gravities of the artificial crystalline feldspars which admit of exceptionally accurate observation, on account of the chemical purity of the specimens, is also a straight line over practically the same range.

5. No natural feldspar is known with a lower specific gravity than albite.

The following preliminary figures were given:

| | Melting Points. | Specific Gravity (Crystals). | Specific Gravity (Glass). |
|---|---|---|---|
| An .......... | 1532° C. | 2.764 | 2.70 |
| $Ab_1An_5$ ....... | 1503° | 2.736 | 2.65 |
| $Ab_1An_2$ ....... | 1464° | 2.702 | 2.60 |
| $Ab_1An_1$ ....... | 1420° | 2.670 | 2.55 |
| $Ab_2An_1$ ....... | 1374° | | 2.48 |
| $Ab_3An_1$ ..about | 1345° | | 2.46 |
| Ab .......... | | | 2.38 |

ALFRED H. BROOKS,
*Secretary.*

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 583d meeting was held March 26, 1904. The election of twelve new members was announced.

Mr. L. A. Bauer reported that magnetometer records showed slight earthquake shocks on March 16 and 21.

Mr. Bergen Davis, of Columbia College, spoke on 'The Theory of the Electrodeless Discharge.' A receiver containing gas is placed in the field of a coil through which an alternating current passes; when the field reaches a certain minimum potential there is a white discharge through the gas; this potential was determined as a function of the gas density and alternation-frequency. The results were found to be in close accordance with the theory of electrons.

Mr. P. G. Nutting then spoke on 'The Dynamics of a Moving Charge,' presenting systematically the dynamical principles that underlie the theory of electrons, and pointing out among other things the great differences in the nature of the fields produced by electrical charges moving at different velocities.

THE 584th meeting was held April 9, 1904, Vice-president Littlehales presiding.

Dr. Bauer reported that the earthquake shock of March 16 was recorded by the magnetograph at Baldwin, Kansas; such records have now been found made on about thirty different dates.

Dr. R. A. Harris, of the Coast and Geodetic Survey, presented a paper on 'Some Indications of Land in the Vicinity of the North Pole.'

The indications of land were based chiefly upon (1) the direction and velocity of the surface currents, known, in part, by the drifting of the *Advance* and *Rescue*, the *Jeannette* and the *Fram*; (2) the very old ice found northeast of Alaska; (3) the tides at Bennett Island, at Pitlekaj, along the northern coast of Alaska, and in the Arctic Archipelago. At Bennett Island the mean range of tide is 2 feet; at Pitlekaj, 0.2 foot; at Point Barrow, 0.4 foot, the flood there coming from the west.

The main conclusion arrived at was that a large trapezoidal tract of land may extend from near the North Pole towards Alaska and eastern Siberia—one corner lying nearly north of Bennett Island; another, a little west of north from Point Barrow; a third, a comparatively short distance northwest of Banks Land; and a fourth corner, north of Lincoln Sea.

The observations of Thomas Simpson show a remarkable change in the time of tide on the northern coast of Alaska near the eastern boundary. This seems to indicate that one or more islands probably lie not very far off to the northward of this locality.

The subject was further discussed by Dr. Dall.

Mr. George R. Stetson then read a paper on 'President Stiles and his Times, Yale, 1778–1795,' based on the recently published voluminous diaries. These were summarized, presenting a vivid picture of the political, intellectual, social and religious conditions of the times.

CHARLES K. WEAD,
*Secretary.*

THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY GEOLOGICAL JOURNAL CLUB.

The club during the last month has devoted much of its time to the reviewing of standard papers on ore deposits, for the benefit of students interested in economic geology. These articles were reviewed by L. T. Buell, C. H. Clapp, M. Rubel, G. G. Wald, A. H. Allen, W. G. Ball and B. L. Johnson. The other articles reviewed were:

B. L. Johnson, 'Native Gold Original in Some Metamorphic Gneisses' (*Eng. and Min. Jour.*, February 4, 1904); S. Shapira, 'Mining in Korea' (*Eng. and Min. Jour.*, March 3, 1904); W. L. Whittemore, 'Origin, Properties and Uses of Shale' (*The Michigan Miner*, November, 1899, to February, 1900); J. G. Barry, 'Controlling Sand Dunes in the United States and Europe' (*Jour. of Geog.*, March, 1904); E. Burton, 'The Glacial Geology of Tasmania' (*Quart. Jour. of the Geol. Soc.*, February, 1904); H. W. Shimer, 'Evolution of the Mosasaurs' (*Jour. Geol.*, February, 1904); C. E. Danforth, 'The American Mining Engineer' (*Eng. and Min. Jour.*, February 25, 1904).

Dr. D. W. Johnson spoke on 'A Problem in River-Capture.' His paper dealt with the present and former courses of the Tennessee River, and showed evidence for and against the present theory of its capture as proposed by Hayes and Campbell. Dr. Johnson is now in the field, making further investigation in this problem.

G. F. Loughlin,
*Secretary.*

THE OHIO STATE ACADEMY OF SCIENCE.

The thirteenth annual meeting was held at Denison University, Granville, November 27, with about thirty members in attendance.

In the course of the year the academy has published, in addition to its 'Annual Report,' three 'Special Papers': No. 5, 'Tabanidæ of Ohio, with a Catalogue and Bibliography of the Species from America North of Mexico,' 63 pages, by James S. Hine; No. 6, 'The Birds of Ohio, A Revised Catalogue,' with copious notes, 241 pages, by Lynds Jones; No. 7, 'Ecological Study of Big Spring Prairie,' 96 pages, by Thomas A. Bonser. The studies upon which these papers were based were largely carried on by aid from the Emerson McMillin Research Fund, and the expense of publication was mainly met by the further aid of the same fund. The series of special papers and the annual reports will be continued, but hereafter the *Ohio Naturalist* will be the official organ of the academy and in it will be published the abstracts and papers of less than 1,500 words.

The officers chosen for the ensuing year are:

*President*—E. L. Moseley.

*Vice-Presidents*—Lynds Jones and L. H. McFadden.

*Secretary*—F. L. Landacre.

*Treasurer*—Herbert Osborn.

*Members of the Executive Committee*—W. E. Wells and W. F. Mercer.

*Member of Publication Committee*—James S. Hine.

*Trustee*—W. R. Lazenby.

*Librarian*—W. C. Mills.

Correspondence regarding publications may be addressed to W. C. Mills, Page Hall, Ohio State University, Columbus, O.

The address of the president, C. J. Herrick, was on 'The Doctrine of Nerve Components and Some of its Applications.'

The following papers were read:

Edward L. Rice: 'Preliminary Report on the Development of the Gill in *Mytilus*.'

Charles S. Mead: 'Comparative Chart of the Vertebrate Skull.'

F. L. Landacre: 'The Protozoa of Sandusky Bay.'

F. L. Landacre: 'A New Peritrichous Infusorian.'

Max Morse: 'Report on the Reptiles and Batrachians of Ohio.'

L. B. Walton: 'Cataloguing Museum Collections.'

L. B. Walton: 'A Practical Dissecting Tray.'

Herbert Osborn: 'A Further Contribution to the Hemipterous Fauna of Ohio.'

J. G. Sanders: 'Report on the Scale Insects of Ohio.'

Chas. S. Mead: 'Report on the Orthoptera of Ohio.'

James S. Hine: 'A Supplement to the Odonata of Ohio.'

A. F. Burgess: 'Notes on the Introduction of the Chinese Ladybird, *Chilocorus similis*, in Ohio.'

Herbert Osborn: 'Notes on a Macropterous *Phylloscelis atra.*'

Max Morse: 'The Breeding Habits of the Myriopod, *Fontaria Indianæ* Boll.'

Edward L. Rice: 'A Statistical Plea for Nature Study.'

Lewis G. Westgate: 'Shore Line Topography between Toledo and Huron, Ohio' (lantern slides).

J. H. Todd: 'Some Rare Forms of Aboriginal Implements.'

Edo. Claassen: 'List of the Mosses of Cuyahoga County and of Several Other Counties of Northern Ohio.'

J. H. Schaffner: 'Extra-Floral Nectaries and Other Glands.'

John H. Schaffner: 'Notes on Nutating Plants.'

Otto E. Jennings: 'Notes on Some Rare and Interesting Ohio Plants.'

Wm. R. Lazenby: 'The Keeping Qualities of Apples.'

Wm. R. Lazenby: 'Seeds of Celastraceæ.'

L. B. Walton: 'Variation and Environment.'

W. A. Kellerman: 'Further Floristic Studies in West Virginia.'

W. A. Kellerman: 'Additional Infection Experiments with Species of Rusts.'

W. A. Kellerman: 'Mycological Flora of Cedar Point, Sandusky, Ohio' (abstract).

W. A. Kellerman: 'Group Names in Natural History.'

W. A. Kellerman: 'Historical Account of Uredineous Culture Experiments, with List of Species' (abstract).

W. A. Kellerman and O. E. Jennings: 'Annual Report on the State Herbarium.'

E. L. Moseley,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### 'HORSES' NOT HORSES.

The notice by E. C. Case of 'The Tree Dwellers' exposes a truly remarkable view of nature and the relations of 'horses' of the present epoch to animals of the past. That picture of 'tiny little creatures' with 'five toes on each foot' flying from dinosaurs and escaping by climbing trees involves as grotesque confusion of time, place and adaptation of structure as could well be conceived. But the critic has not shown up one of the most misleading characteristics. The author, after asserting that 'long before the tree-dwellers lived there were wild horses' which were 'tiny little creatures,' naïvely adds, 'Perhaps you would not think that they were horses at all'! If 'you' did not think so 'you' would be perfectly right and any one who thinks otherwise perfectly wrong. The use of the word horse in such an enlarged sense has been to some extent encouraged by those who know better, but it is extremely deceptive. I have asked a dozen persons of more than average intelligence and culture (school teachers and college graduates) what idea they derived from the paragraphs in question, and found that those who had no special knowledge of zoology were entirely misled; they imagined an animal like an ordinary horse (more like a horse than a zebra or an ass is like a horse), differing simply in having five toes besides stripes like a zebra. Now, every instructed zoologist would know that such a characteristic as five (or four) toes must necessarily be coordinate with innumerable modifications of other parts and that, consequently, an animal so endowed must differ vastly more from a horse than an ass or a zebra does. In fact, every student of recent mammals would place the extinct beast in an entirely different family from the horse.

But no ungulate in the line of the horses with five toes has been discovered! The nearest approach to it is the *Hyracotherium* or *Eohippus* of the lower Eocene and that type had only four front toes and three hind ones; its jaws were relatively short, its teeth quite different from a horse's, and, in fine, its associated characters compel zoologists to differentiate it as the representative of a peculiar family—the Hyracotheriids. In an article (Horse) by a special student of the subject (Dr. William D. Matthews), just published in the Encyclopedia Americana, it is aptly stated that the 'first ancestor of the horse line is very difficult to distinguish from the contemporary ancestors of tapirs and rhinoceroses.'

Furthermore, I object to the assumption that the early representatives of the equine phylum were striped like a zebra. The only basis for such an assumption is that most of

the modern equids actually have such stripes, but the diversity between them leads one to suspect the universality of the tendency and to believe that it is of recent origin. At any rate, no one has a right to take it for granted that primitive forms were striped. The evidence, such as it is, is against the assumption.

Another pure assumption is that the primitive equoidean animals lived especially in the marshes. (The unfortunate author of 'The Tree Dwellers' of course misread 'nature' in postulating that 'the land at that time'—when five-toed horses lived!—'was almost entirely covered with water.') The assumption is based on the obvious fact that a four- or five-toed spreading foot is better adapted for progression on soft earth than a soliped, but there is no reason for confining such animals to marshes. The elephants and rhinoceroses are not marsh-loving animals.

The misuse of the word horse is in natural sequence to the same idea that has been carried to an extreme in 'The Tree Dwellers'; it is the expression of a contemptuous condescension or concession to such as are assumed to be insufficiently educated or receptive to be addressed in more precise language. In the extreme form—disconnected sentences and crude verbiage—analogous language is known as 'baby talk.' Science is scarcely food for babies.

Theo. Gill.

## *SPECIAL ARTICLES.*

### THE INFLUENCE OF CLIMATE AND SOIL ON THE TRANSMITTING POWER OF SEEDS.*

In speaking of the influence of soil and climate on the transmitting power of seeds, I will confine myself to certain practices which seedsmen have been taught to follow through long experience, as indicative of certain botanical facts, rather as if these facts had been established by scientific study and experiment.

Speaking first of leguminous plants, in the 'Extra Early' varieties of garden peas the desirable form of vine is one eighteen to forty inches high, and of a determinate growth, by which term I mean a vine that before the lowest and first formed pod has become too large for use as green peas, has completed its elongation and has its apex crowned by a well-formed pod or at least one well out of the blossom. The objectionable form is a vine twenty-four to sixty inches in height, which even when the lowest pod is fully ripe is still growing having its apex covered with blossoms and buds. Such plants as these last are called by seedmen 'wicks' or 'offs,' and a stock of 'Extra Early' peas is valued in inverse proportion to the number of such plants it produces. I never have seen a stock which did not occasionally produce them, and in number varying with different conditions of cultivation. On very rich soils, or those which have been recently fertilized with stable manure, there will be a great many more such plants developed than on a poorer soil. A stock which, when grown on a white clay soil of uniform composition, will ripen down very uniformly and not show more than a dozen such 'offs' to the acre, will, when planted on a mucky soil or one which has been enriched by fresh stable manure, give a dozen 'offs' to the square rod.

As an illustration in detail is a case when three large fields of very favorable soil were planted with the same stock, two of them when visited showed practically no 'offs,' nor were there many to be seen in the third field, except in a double row of circles, each about ten feet in diameter, where piles of manure had been spread, and in each of them there were twelve to twenty-five bad 'offs' more than could be found on an acre of the rest of the field.

Seedsmen find that if the seed from such 'off' plants grown from good stock is planted on soils favorable for the development of the true type, it will produce few, very few, often no more 'off' plants than seed from plants of the true type grown from the same stock; but if seed from the 'off' plants is sown on soil favorable for the development of 'off' plants, they will produce more 'offs' than seeds from the true type, and this tendency to produce 'off' plants on either favorable or unfavorable soil increases very rapidly with the number of consecutive generations of 'off' plants back of the seed in question. An illustration was given of precisely similar results

* Read before Botanical Club of Washington.

with 'American Wonder' peas when the character of soil favorable for the most desirable type is the opposite of that favorable for the best 'Extra Earlies.'

Seedsmen commonly believe that, in the case of peas, the character of the soil has a marked influence over the character of the plant, and that this influence extends to and is carried by the seed, but that such soil influence is decidedly cumulative in its effects, so that in practice they attach little importance to it for *one season*, but carefully avoid the use of stock seed which has been submitted to such influence for consecutive years.

Again in the case of garden beans, the tendency of rich, moist, heavy soil is to produce thick, fleshy pods slow to mature, while that of warm sandy land is to the production of flatter, less fleshy and quicker maturing pods. I can best illustrate this by experience. Some ten years ago I sent each of two growers living within a mile of each other, seed of 'Valentine' bean of precisely the same stock grown the previous year in the same field, which was a rich clay loam. One of these, whom I will call *C*, planted on rather heavy, rich soil, the other, *S*, on a light warm but rich sandy one. The next season *C* received seed grown by *S* and *S* seed grown by *C*, while a third man, *M*, some five miles away, on rich loam soil, received equal parts of both. When I visited the fields I noticed that in *C*'s field, which I supposed was planted wholly with seed grown by *S*, there were ten rows which differed from the rest and were such as I would expect if seed from *C* was planted, and I tried to account for them by extra manure, etc.; but I learned that as there was not quite enough of the seed from *S* sent him, he had filled out with some of his own, and I had detected the exact row where the seed was used. I then visited *M* on loam soil, and while I could tell that one part of the field was planted with *C* stock and the other with *S*, I could not detect the line between them.

These experiences seem to indicate that in leguminous plants soil does have an influence which is carried in the seed, and is cumulative in character, but in all my experience I have never seen any influence of the climate over the seed of leguminous plants.

The only gramineous plant with which I have had a large experience is sweet corn, and here the case of legumes is reversed. I have never been able to detect any influence of soil over the character of the seed produced, but I believe that climatic condition does have a marked influence, and that the difference between stock grown east and that grown west is the result of climatic rather than soil condition. People who use large quantities of sweet corn are very positive in their belief that seed produced in the eastern states gives a better product than that grown at the west. Some seedsmen agree with them, others maintain that if *eastern stock* seed is used just as good corn can be grown in the west. It seems to me that that *if* not only undermines their contention, but shows that seedsmen have a practical belief in the cumulative influence of soil and climate.

Turning now to cucurbits, in my experience I could never detect any effect of either soil or climate on seed of cucurbitaceous plants of the *same stock*. I don't wish to be understood as saying that soil and climate have no influence over the fruit, for they do quite as much as with any plant, but that this difference is not carried in the seed. As an illustration the writer has knowledge of a case where seed from small but select fruits grown in Michigan was sown in Oklahoma by the side of seed from large plants of the same pedigree grown in Oklahoma, and the result was equally large fruit in both cases. Also, in another case an old and experienced grower in Michigan, who claimed that he should be paid more for seed grown in Michigan, because earlier and better, was given seed of the same stock, grown for three generations in Michigan and for four generations within 200 miles of Gulf of Mexico, to plant side by side, and told that if he could detect any difference in the crop, his request would be considered, but he was unable to do so.

I have had the same sort of results with cucumber, muskmelon and squash, and it has made me think that seed of cucurbits do not carry influences of soil and climate, even when

such influence has accumulated for several generations. If time would permit I might go on and speak of tomatoes, cabbage and onion, each of which in my experience seems to have distinct habits in this respect, and considering all these cases it seems to me that plants of different natural orders differ in the degree to which influences of soil and climate are transmitted through the seed.

Will W. Tracy, Sr.

## CURRENT NOTES ON METEOROLOGY.

### CHANGES OF CLIMATE IN CENTRAL AFRICA.

It is reported (*Pet. Mitth.*, X., 1903) that Lake Shirwa, southeast of Lake Nyassa, in central Africa, has entirely disappeared. Desiccation has been going on for many years, but the last stages in the process were very rapid. This lake used to be shown on the maps as an oval-shaped body of water, about thirty miles long and ten to fifteen miles wide. It now consists of a few small ponds. Livingstone discovered the lake in 1859. Lake Ngami, also discovered by Livingstone, has since disappeared. These changes seem to be a manifestation of a gradual desiccation which is going on in central Africa, but it is important that they should be more carefully studied before any definite conclusions are drawn. The recent reports to the effect that the Sea of Azov is drying up are misleading, in that the apparent desiccation seems actually to be due to a silting up of the lake.

### A NEW DROSOMETER.

The measurement of dew has always given trouble, because no drosometer has ever commended itself for universal use, and the results obtained by different methods have not been accurate, satisfactory or comparable. In *Das Wetter* for March, Ferle, of the Agricultural Experiment Station of Peterhof-Kurland, describes a new kind of drosometer, which he has found very useful, viz., a piece of specially prepared paper, soaked in a chemical solution. This paper is exposed over a box placed on the ground at night, and the amount of dew is indicated by the discoloration of the paper. A scale of discoloration, determined by experiment, is adopted, and the entry in the observation record book, based on the amount of discoloration, gives the amount of dew which formed during the night. Three kinds of paper are used, the first for the smallest amounts, the second for larger, and the third for the largest amounts. It is best to expose two kinds of paper, selected according to the season, so that, in case the amount of dew is too great to be indicated by one sheet, it may be recorded by the discoloration of the other paper.

### METEOROLOGICAL OBSERVATORY ON MONTE ROSA.

At the instance of the Italian Alpine Club, and with the support of Queen Margarita, the Duke of the Abruzzi, and of the Italian Ministry of Agriculture, an observatory has been erected on Monte Rosa, at an altitude of 4,560 meters (14,960 ft.) above sea level. Next to the Vallot Observatory on Mont Blanc, this is the highest meteorological station in Europe. Observations are to be begun during the coming summer. The observer is to live at the summit throughout the summer months, and during the winter when weather conditions are favorable. The observatory is to be open to scientific men of all nationalities who wish to carry on investigations there. The observations made on Monte Rosa will be of special value in connection with the international balloon ascents. The Monte Rosa Observatory will have, as companion Italian institutions, the Etna and the Monte Cimone observatories, at 2,942 (9,650 ft.) and 2,162 (7,095 ft.) meters respectively.

### METEOROLOGICAL INSTITUTE OF ROUMANIA.

Amid the disturbed political conditions on the Balkan Peninsula, the Meteorological Institute of Roumania, under the able directorship of Dr. Hepites, continues its excellent work. Vol. XVI. of the *Annals* of the institute is at hand, comprising over 700 quarto pages, containing the annual report of the director for the year 1900; memoirs on the rainfall, earthquakes, climatology and magnetic observations of 1900; the regular hourly observations of all the elements at Bucharest, as well as the means for the 16 years 1885–

1900, for the successive lustra between 1885 and 1900, and the observations made at 52 stations of the second order during 1900. There are now 395 rainfall stations in Roumania. An index of the publications of the Roumanian Meteorological Institute from 1885 to 1903, comprising 31 octavo pages, offers the best of evidence as to the scientific activities of this institution.

R. DEC. WARD.

### *ERWIN E. EWELL.*

ERWIN E. EWELL, lately first assistant chemist of the U. S. Department of Agriculture and more recently representative of the German Kali Syndicate in the Southern States with headquarters at Atlanta, Georgia, died in New Orleans, La., on February 7, after a brief but severe attack of grippe and rheumatism, followed by typhoid fever.

Mr. Ewell was born in Washington, Michigan, in 1867. His education was secured entirely through his own exertions since, through the death of his father, he was at an early age thrown entirely upon his own resources. He was graduated from the University of Michigan in 1890 and in the same year entered into the service of the Bureau of Chemistry of the Department of Agriculture. His efficiency led to his advancement to the position of principal assistant chemist of the department, and he contributed very largely to the success of the bureau. He was greatly interested in standards of measurements, was chairman of the committee of the American Chemical Society to secure better uniformity and accuracy in the standards in use and he was active in promoting the movement which finally led to the establishment of the bureau of standards. In 1903 he entered the service of the German Kali Syndicate and had begun with his characteristic energy and enthusiasm the presentation of the importance of potash salts in the nutrition of farm crops.

The many warm friends of Mr. Ewell will find in his death a serious personal loss and the scientific world will miss one of its most effective workers.

### *SCIENTIFIC NOTES AND NEWS.*

THE summer meeting of the American Chemical Society will be held at Providence, R. I., June 21–23.

THE Alumni Association of the School of Applied Science of Columbia University has arranged to have painted a portrait of Dr. Charles F. Chandler, head of the Department of Chemistry. The portrait will be presented at the sesquicentennial celebration in October, when Dr. Chandler will have been for forty years professor of chemistry at the university.

THE alumni of the engineering department of the University of Michigan, now resident in Chicago and vicinity, have presented to the university a portrait in oil of the late Professor Charles E. Greene, dean of the engineering department from its organization until his death.

PROFESSOR W. OSTWALD gave the Faraday lecture of the Chemical Society at the Royal Institution, London, on April 19. At the close of the lecture he was presented with a medal bearing the image of Faraday, which had been specially struck for the occasion.

PROFESSOR L. V. KELLOGG, of the Department of Entomology of Stanford University, has been elected a member of Société Entomologique de France.

M. GUICHARD has been elected a member of the Paris Academy of Sciences in the section of geometry.

THE University of Glasgow has conferred its Doctorate of Laws on Professor Mendelejev, the eminent chemist.

AMONG the distinguished lecturers at the summer session of the University of California, which begins on June 27, are Professor Svante A. Arrhenius, of the University of Stockholm; Professor Hugo De Vries, of the University of Amsterdam; Sir William Ramsay, of University College, London, and Professor James Ward, of the University of Cambridge.

PROFESSOR RUSSELL H. CHITTENDEN, director of the Sheffield Scientific School, Yale University, on April 29, tendered a banquet in honor of Dr. C. S. Sherrington, professor of physiology in the University of Liverpool, who

is delivering the Silliman lectures at Yale. There were twenty guests, including President Hadley, Yale; Professors Bowditch and Porter, Harvard; Dr. Graham Lusk, New York; Dr. Frederic S. Lee, Columbia; Professor Reichert, Pennsylvania; Dr. Francis Bacon, New Haven; Professor Dunham, New York; Dr. W. H. Carmalt, New Haven; Professor L. B. Mendel, Yale; Dr. Otto G. Ramsay, Yale; Professor Abbott, Pennsylvania; Dr. J. P. C. Foster, New Haven; Professor Yandell Henderson, Yale; Dean Herbert E. Smith, of the Yale Medical School; Mr. Horace Fletcher, Venice, and Dr. Sherrington.

Captain Bernier, who is going out in charge of the Canadian Arctic expedition, was among the passengers by the steamship *Kaiser Wilhelm II.* which arrived at Plymouth on April 18. He was accompanied by 24 of his crew, and went on in the ship to Bremen, whence they will navigate the German ship *Gauss,* which has been purchased by the Canadian government.

Dr. John M. Macfarlane, professor of botany at the University of Pennsylvania, has been granted a four months' leave of absence to make botanical investigations in England, Italy and Switzerland.

Assistant Professor Herbert N. McCoy, of the Department of Chemistry of the University of Chicago, has gone abroad to visit German laboratories.

Professor G. J. Peirce, of Stanford University, intends to spend June and July with Professor Pfeffer in the laboratory of plant physiology at Leipzig. He will attend the meeting of the British Association for the Advancement of Science at Cambridge and will spend October and November at the Marine Biological Station at Naples, where he will occupy one of the tables maintained by the Carnegie Institution.

Professor Gilbert D. Harris, of the department of geology of Cornell University, spent the winter months in Louisiana as geologist of the state survey, exploring and mapping the oil regions.

Professor W. J. Kennedy, chief of the department of animal husbandry at the Iowa State College of Agriculture, has been commissioned by the Department of Agriculture to spend a year in Europe studying the live stock industry in various countries.

M. Hamy, professor of anthropology at the Paris Museum of Natural History, has been given leave of absence for the year 1904. His courses will be given by M. Verneau.

Mr. A. G. Ruthven, of the Zoological Department of the University of Michigan, is making a special study of the North American species of garter snakes (*Eutænia*), and wishes to receive specimens in large numbers from all parts of North America. Collections of these snakes will be determined for duplicates. Directions for the collection, preservation and shipment may be secured upon application to the above address.

Mr. L. B. Elliott, who completed his studies at the University of Iowa in 1892 under the personal direction of Professors Calvin and MacBride, and who has since that time been connected with the Bausch & Lomb Optical Company, Rochester, N. Y., and editor of the *Journal of Applied Microscopy and Laboratory Methods* since its beginning in 1898 until its recent discontinuance, has severed his connection with that company to accept a position with the T. B. Dunn Company, of Rochester, N. Y. Mr. Elliott will continue his private work in laboratory photography and biology as heretofore. His address is 17 Birr Street, Rochester, N. Y.

Mr. Charles F. Townsend, director of the New York Aquarium, gave the tenth lecture in the course before the College of the City of New York on April 29, his subject being 'The Depths of the Sea.'

At the annual graduation ceremonial of the University of Glasgow, on April 18, a medallion bearing a bas-relief of John Young, professor of natural history and keeper of the Hunterian Museum from 1856 to 1892, was presented to the university.

President Schurman, of Cornell University, will give an address in memory of Herbert Spencer, on Sunday, May 7.

The Institute of France has appropriated 10,000 francs from the income of the fund left

by M. Debrousse for the publication of the works of Leibnitz.

SIR CLEMENT NEVE FOSTER, F.R.S., professor of mining in the Royal College of Mining, London, died on April 19, aged fifty-three years.

F. J. WELLS, assistant professor of agricultural physics in the college of agriculture of the University of Wisconsin, died on March 1.

GEORGE A. MARTIN, editor of the *New England Farmer* and a well-known writer on agricultural topics, died at his home in Brattleboro, Vt., on April 16, aged seventy-three.

DR. CHARLES SORET, formerly professor of experimental physics at Geneva, died on April 5, at the age of fifty years.

DR. ANDREW PEEBLES AITKEN, professor of chemistry and toxicology, in the Royal Veterinary College, Edinburgh, died on April 17. He received the M.A. degree from Edinburgh in 1867.

THE American Geographical Society has received a bequest of $30,000 from Sarah M. de Vaugrigneuse.

THE Department of Conchology of the American Museum of Natural History has received as a gift from Mr. Albert H. Storer, of New York, the valuable collection of shells which was made by his father.

M. J. J. SIEGFRIED has given to the Institute of France the Castle of Langeais, with the sum of 100,000 francs for the costs of installation and an endowment yielding an income of 10,000 francs for its support.

THE Association of American Agricultural Colleges and Experiment Stations will meet during the week beginning October 30, probably at Des Moines, Ia.

ENGINEER BROUSNEFF, who was sent out in the spring of 1903 by the Imperial Academy of Sciences, at St. Petersburg, in company with Lieutenant Kolchak and a number of experienced Yakuts, towards New Siberia and Bennett Island, to search for the Polar expedition headed by Baron E. Toll, has returned without results. The academy has issued the following notice: Baron Edward Toll, chief of the polar expedition sent out by the Academy of Sciences, left the Bennett Island, lying north of New Siberia, on October 26 (November 8), 1902, taking a southern direction. He was accompanied by the astronomer Seeberg and two Yakuts. The party seems to have been carried away by the ice. As the researches hitherto made have been in vain, a reward of 5,000 roubles (about $2,500) is offered by the Academy of Sciences for finding the whole expedition party, or any part of it, and a reward of 2,500 roubles for giving the first exact indications of tracing the party.

THE director-in-chief and other members of the staff of the New York Botanical Garden will be pleased to receive members and their friends at the grounds in Bronx Park on every Saturday in May and June. The train leaves Grand Central Station at 2:35 P.M., for Bronx Park, returning at 5:32 P.M. Opportunity will be given for inspection of the museums, laboratories, library and herbarium, the public conservatories, the herbaceous collection, the hemlock forest, and parts of the arboretum. The walk planned will be a little over a mile. Lectures will be delivered in the lecture hall of the museum building at 4:30 o'clock, as follows:

April 30.—'Japan, the Land of Lacquer and Bamboo,' by Dr. C. F. Millspaugh.

May 7.—'The Form, Habits and Relationships of the Cactuses,' by Dr. N. L. Britton.

May 14.—'The Vegetation of the Delta of the Colorado River, and of Baja California,' by Dr. D. T. MacDougal.

May 21.—'Explorations on the Yukon River, Alaska,' by Dr. Arthur Hollick.

May 28.—'Arctic and Alpine Plants,' by Professor F. E. Lloyd.

June 4.—'Carnivorous Plants,' by Professor H. M. Richards.

THE U. S. Geological Survey completed the twenty-fifth year of its existence on March 3, 1904. The quarter-century anniversary happened to fall near the date set for the opening of the Louisiana Purchase Exposition at St. Louis, at which the survey will make an exhibit. It is hoped that this exhibit will increase the popular interest in the survey, and in this connection it has been thought

desirable to place before the public, by means of a small bulletin, an account of its organization and work and the results it has achieved. Copies of this bulletin will be distributed at St. Louis and other copies may be obtained by application to the director of the U. S. Geological Survey, Washington, D. C. The bulletin, which is No. 227 of the survey series, is entitled, 'The United States Geological Survey: Its Origin, Development, Organization and Operations.'

## UNIVERSITY AND EDUCATIONAL NEWS.

THE Ohio legislature has appropriated for the next biennial period for the Ohio State University the following amounts:

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| Current expenses | $635,000 |
| New chemical building | 100,000 |
| Ceramic and mining building | 85,000 |
| College of Agriculture | 75,000 |
| Equipment of chemistry and physics buildings | 25,000 |
| Emergency fund | 15,000 |
| Total | $935,000 |

This is about 50 per cent. increase over the largest preceding appropriation. The university has other sources of income which will yield approximately $200,000 for the biennial period.

THE will of the late A. C. Hutchinson, according to which the Medical College of Tulane University receives nearly $1,000,000, has been sustained by the Supreme Court of the state of Louisiana.

NEW YORK UNIVERSITY has received an anonymous gift of $12,500 for the Medical College.

THE reorganized Board of Regents having charge of the educational affairs of the State of New York held its first meeting at Albany on April 28 when Dr. Whitelaw Reid was elected chancellor. The following appointments were announced: *First Assistant Commissioner,* Howard J. Rogers, Albany; *Second Assistant Commissioner,* Edward J. Goodwin, New York City; *Third Assistant Commissioner,* Augustus S. Downing, New York City; *Director of Libraries,* Melvil Dewey, Albany.

A 'JOINT Announcement of Field Courses in Geology,' for the summer of 1904, has lately been issued by several universities, with the object of placing concisely before American students the opportunities for practical study of this science in different parts of the country. Fifteen universities were invited to take part in the announcement: four responded with statement of courses for the current year; others stated that they would probably cooperate in the plan of joint announcement if it were repeated in 1905. Chicago and Harvard each offer four courses; five courses in the Rocky Mountain region, two in the upper Mississippi Valley, and one in New York State. Johns Hopkins gives opportunity for professional work in connection with the Geological Survey of Michigan. Columbia has a brief spring course, limited to her own students. Scholarships are available in connection with some of the courses. The circular can be had on application to the geological department of any of the universities concerned.

DR. BARTON WARREN EVERMANN, assistant in charge of scientific inquiry in the U. S. Bureau of Fisheries, has been asked to give a course of lectures on fish culture and game protection to the seniors of the College of Forestry of Yale University. The course will consist of lectures and field work and will be given during the fortnight beginning May 9, at Milford, Pa., where the class will be engaged in field studies.

THERE will be a vacant instructorship in physics at Purdue University next June. The salary for the first year will be eight hundred dollars.

DR. JOHN DEWEY, of the University of Chicago, has been elected professor of philosophy at Columbia University.

DR. CHARLES R. BARDEEN, associate professor of anatomy at the Johns Hopkins University, has accepted the chair of anatomy at the University of Wisconsin.

ASSISTANT PROFESSOR VICTOR LENHER, Charles Elwood Mendenhall and William Swan Miller, of the University of Wisconsin, were made associate professors by the action of the regents of the university at their April meeting.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 13, 1904.

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**MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.**

## *SOME ASPECTS OF THE DEVELOPMENT OF COMPARATIVE PSYCHOLOGY.*

IT is probably most satisfactory in every way, if an address is to be general, that it shall have its foundation in the line of research which has most engaged the author for a number of years past. In harmony with this principle it was open to me to choose either some subject bearing on the anatomy and physiology of the nervous system, or one dealing with animal intelligence. To have treated the former in a way satisfactory to myself would have implied considerable illustration and the use of the lantern, which could likely not be carried out without breaking in on an evening, and that was more than I cared to ask the section to do; hence the selection of 'Some Aspects of the Development of Animal Intelligence,' as the topic of this address, the treatment of which must, in the nature of the case, be incomplete.

It is no doubt true that man is more dependent than any other animal on his environment, if we restrict that term to the material world about us, but the very expression 'Every man is the product of his age' conveys the truth that the greatest genius can get only so far beyond the average thought of his time. As Darwin long ago pointed out, the most important factor in man's environment is man himself. One has scarcely emerged from infancy before the accumulated forces of the ages in human traditions and knowledge begin to mold the developing human being, and determine what he shall be. So that, be as independent and original as any one may,

he is still in a sense a product of his environment. Of anything analogous to this among the lower animals there is little, consequently in taking account of the state of comparative psychology as it is to-day, and the steps by which it has been brought to its present development, one can not for a moment lose sight of the general trend of thought and the whole sum of the forces that we term environment. If it be a fact, as it is, that men to-day regard animals in a wholly different light from that of the middle ages and long after, it is because our general philosophy of life and our point of view have greatly changed.

Art is in an especial way the reflection of the thought and feeling of the time, and one cannot but know the indifference with which the old masters treated nature and, in most instances, especially animals, which were with them simply objects to fill in a scene either in the foreground or more frequently the background. Man was with them, as with the masses of the people, the center of this mundane universe; and all things had to be represented as correspondingly subordinated to him. It was only comparatively recently that animals were painted simply because they were animals and not the mere servants or playthings of man. It is impossible to conceive of a Landseer in the age of Dante, and one is not greatly surprised that even so eminent a philosopher as Descartes should have regarded animals merely as automata. Not a few in this room can remember the time when with the masses the attitude toward the dog might be summed up in the question, What good is he? The idea that a dog might be a creature worthy of serious study with a view of ascertaining his place in the psychological scale certainly did not enter into the minds of men generally prior to Darwin. But that great transformer, the doctrine of organic evolution, has wrought wonders for psychology as well as biology. When man conceived of the world as developing, rather than as completed, the whole attitude of the reflecting animal man was changed.

It is absolutely impossible to understand the rapidity of the progress of comparative psychology, or even the change of front, within so short a period as twenty years, without bearing in mind this cardinal fact. How truly incomprehensible to most scientists must have been even fifty years ago, such a problem as that which has attracted the attention of some of the best biologists and psychologists of late, namely, the degree to which consciousness extends back and down into the lower strata of the animal kingdom. Men are now even asking why we should deny all glimmerings of consciousness to plants—whether there is not a nexus between the animate and the inanimate of a kind more intimate than we have supposed. After men began to concede that animals were more than mere living machines worked by their senses—if they even gave enough attention to the subject to get that far—it was some time before intelligent people got beyond 'instinct,' the rough-and-ready cant phrase with which to place an animal in a classification that separated it immeasurably from man. People hardly conceived of man as a creature with as many instincts as the brutes. Rapidly, however, of late have the masses begun to realize that not instinct alone, but intelligence, must be invoked to explain animals. As a natural consequence of this change—this preparation of the soil of the human mind to receive new ideas—there came a wave of enthusiasm which led some of those who were naturally lovers of animals, and also serious students of the nature of their inner life, to go too far—to attempt to explain the animal too fully by the man, to read into him all that characterized the creature of the highest intelligence. However, this is,

on the whole, scarcely to be regretted, for interest was through this sympathetic bond awakened, and prepared the way for that critical investigation of animal psychology which at an earlier period would have been premature.

Naturalists at a time prior to what may be termed the laboratory period, had noted the habits of animals with loving interest, but had not subjected them to a very critical analysis, and certainly had scarcely dreamed of correlating the mental life of even the highest groups of animals with that of man. Darwin had set the example of investigating the mental life of animals and of man by the same method of close observation. A study of his dog and a study of his child were to him of equal interest scientifically, and his records remain among the most valuable of their kind to this day.

Sir John Lubbock soon followed with admirable studies of insects. Huxley remained the critic, and his attitude in regard to animal intelligence is one of the features of that great man's mental character not readily understood. To think that so pronounced an evolutionist should have held views not greatly different from those of Descartes is truly surprising. Lubbock had worthy fellow workers in McCook, Forel, the Peckhams and others. Probably no man did more, in Great Britain at all events, to stimulate the interest not only of scientists, but of that large body of people who read to a greater or less extent the more popular of the scientific journals, than Romanes. He was in a position to devote much time to the subject, and his numerous letters and the replies they called forth in *Nature* have been among the most telling influences of our own time in advancing this subject. He has embodied his views in works, that in spite of all the destructive criticism of the last half dozen years remain valuable both as storehouses of fact and as examples of helpful critical analysis.

Within at the most ten years another great change has taken place. The biologists began to be more accurate, systematic and comparative in their observations; and, most important of all, a different class of thinkers entered the field. If the biologists can be compared to the spearmen or the axemen of the army, the psychologists are the bowmen. They brought to the task, at all events, more skill in mental analysis and, perhaps, a clearer comprehension of the problems to be solved. They were, moreover, better prepared to correlate the data of animal and human psychology and find what was common to both, as well as draw sharp lines of distinction, if, indeed, such lines can be drawn. If, on the one hand, the naturalists had been spasmodic, unsystematic and rather loose in their contributions and superficial in their analyses, the psychologists showed a tendency to substitute words and definitions for realities. Armchair animal psychology has no doubt been evolved from insufficient data—an affair of words rather than of things—nevertheless, great good has resulted for all, as we have been brought to what may be termed the experimental and critical age of comparative psychology.

It was most fortunate that, as successor to Romanes in Great Britain, the subject should have been taken up by a man so thoroughly prepared for his task as Lloyd Morgan, who is at once a biologist, a psychologist and a master of the pen. His works, in spite of the critical acumen they show, can be read by any one with a moderate knowledge of biology and a sympathy with the subject of animal intelligence. And that has given them a wide circulation, a most important matter for the education of large numbers of persons to broader and truer views of the relations of man and his fellow creatures. This is

surely of the utmost importance, if we are to look to a right mental attitude as of more to man than food and raiment.

Still later we see a rise within a very few years of a class of investigators that I presume would prefer to be called the experimental school, but whom I shall designate the laboratory school and the individuals the laborators, for I do not grant that they were the first experimenters. Their researches have practically all been such as can be readily carried out in the laboratory, a fact which explains at once, to a large extent, their excellencies and their defects, especially the latter. This school has, on the whole, been destructive. If it has, on the one hand, brought few bricks to the pile, it has, on the other, boldly attempted to overturn some edifices that were relatively of ancient date and regarded by many with considerable respect. The most extreme representatives of this school deny to animals, not only reasoning and every form of intelligence proper, but even imitation and memory. The whole psychic life of animals not to be explained by instinct was for them the result of the operation of the law of association of ideas; all else was illusion and delusion; previous workers were regarded as prejudiced in favor of animals; they were adjudged to have written as if they held a brief for animals as creatures that mentally were very like man, differing not so much in qualities as in the degree to which they were developed.

All this is wrong, utterly wrong, according to this very modern school, and claiming that anecdotes were rather misleading than helpful, that observations were of little value at the best, it was maintained that there had really, up till then, been no experiments worthy of the name, and that now, for the first time, was there something to be presented on which reliance might be placed, in spite of the fact that some, at all events, of the experimenters had neither biological knowledge nor special experience of any kind with animals, and were plainly prejudiced at the outset against the views that the common sense of mankind, as well as the consensus of opinion among naturalists, had held to be worthy of consideration. One of this school, perhaps to be considered the leader, claimed that with his method one only needed 'a pair of eyes.' This experimenter placed cats in cages twenty inches long, fifteen broad and twelve high, and because they did not, under the stimulus of hunger, speedily manipulate certain mechanisms successfully he, on this and similar evidence, employing also dogs and other animals, proceeded to demolish in very summary fashion the fundamental conclusions of hosts of observers who had occupied as many years in their tasks as he had spent weeks. Some of these conclusions seemed to be absolutely against common sense. Here we had, indeed, a violent reaction against that excess of credulity which it must be confessed had existed, and it again was the natural reaction against that indifference to animals which had characterized preceding ages.

As the experimental methods of the laborators are now attracting so much attention, it will be worth while to examine them a little more fully. I elsewhere criticized, some four years ago, the methods and conclusions of the chief agnostic of this school, Dr. Thorndike, and I see now no reason to change the opinions I then expressed. Indeed, since that time the experience, and I may add the failures of others working along the same lines, have only strengthened the force of my convictions.

Mr. L. T. Hobhouse made a number of experiments on the dog, the cat, the monkey, the elephant and the otter. In the main these tests were carried out under conditions somewhat more natural than those of the experimenters of the school

in question, but still they do not differ sufficiently to free them from the force of the objections which may be urged against all such ways of determining the nature of animal intelligence. Nevertheless, Mr. Hobhouse, using similar methods, came to very different conclusions from Dr. Thorndike, so that it would appear that something more than 'a pair of eyes' is necessary for the solution of the problems of animal psychology. Mr. Hobhouse, from all his experiments and a critical examination of those of others, together with the weighing of the evidence afforded by the most extended and accurate series of consecutive observations on mammals available, came to the conclusion that 'on their own lines and in their own way, some of the more understood mammals have powers equivalent to those of the ape.' He also in criticism of the experimental method says, 'so a dog may show not merely highly developed hunting instincts, but real cleverness in the adaptation of past experience when it is a question of catching a hare, but he may be also an intolerable dullard about opening a box.' Herein lies a great truth which the experimenters have failed in general to note. No animal and no man is equal to his fellows in all respects, and we know that some very able men, some men of undoubted genius, are exceedingly slow in certain directions.

To test an animal's intelligence by mechanisms seems to be about on a par with gauging the nature of a man's intellect by certain 'puzzles' in which, as is well known, many able men are, indeed, 'intolerable dullards.' A set of experiments better adapted for the examination of the intelligence of the group in question, white rats, was that of Mr. Small. He used a maze, which was so arranged that when the animal secured the food that was put in the central portion, he was free from the maze and could return to his cage. The shortest path to the food was 105 feet, and there were 27 corners to be turned. It is a very noteworthy fact that when monkeys were tried in a similar maze they did no better than the rats, in fact scarcely as well. But how fallacious it would be to conclude that the rat's intelligence is equal to that of the monkey. However, Mr. Small seems to have been a somewhat cautious investigator, and his work, including observations systematically carried out on the psychic development of young white rats—which he has been good enough to say was suggested by my own series on our domestic mammals and birds—his experiments with the white rat and his discerning criticism of the work of others, had not a little advanced the subject of animal psychology.

In quite another class and altogether less open to criticism are certain experiments made by Mr. Hobhouse. He ascertained how a dog, left upstairs in a building, would get to his master who called him from outside. While some of the laboratories have almost wholly ignored the individuality of animals, this criticism does not apply to Mr. Hobhouse. As this writer seems to me to have taken, on the whole, about the broadest, safest and most helpful views of animal intelligence, I feel justified, even in so general a treatment of the subject as the occasion permits, in calling further attention to them. Passing by his discussion of instinct for the present, after pointing out that Dr. Thorndike's experiments with cats, dogs and chickens were 'quite outside the range of the animal's ordinary experience,' he says, 'What Mr. Thorndike's experiments prove so far is not that cats and dogs are invariably educated by the association process, that is by habituation alone, but on the contrary that at least some cats and dogs conform in at least one point to the method of acquisition by concrete

experience—they learn in a very few instances.'

Mr. Hobhouse was one of the first to recognize clearly, though I do not say adequately, that the success of the animal in certain situations depends largely on the degree to which it can *attend* to anything in hand. It is not sufficient that an animal be stimulated, as by hunger and the sight of food—to instance a favorite stimulus used by the laborators—the animals must, if it would succeed in certain complicated situations, be able to exercise an inhibitory influence and direct its attention to the essential points in the solution of a problem, and in this respect not only do groups but individuals differ greatly. Speaking generally, the poodle has the power of attention above every other breed of dogs, so far as the learning of tricks is concerned, yet in the hunting field the pointer or setter is incomparably his superior, even in this matter of attention. But there is much in Mr. Hobhouse's generalization, 'that an animal can shift its attention to this or that object, or change within the sphere of perception, but it apparently can not follow out the structure of any complex object with any minuteness and accuracy,' and I would add that it is just here that man is so far in advance of the animal and some individuals, especially among men, superior to others.

The experimental examination of this point, so far as animals are concerned, offers an inviting and possibly fruitful field. Mr. Hobhouse found the Rhesus monkey less attentive than his dog, and not more so than the cat. But attention can be cultivated, as was shown by the improvement of this writer's dog Jack. Both the dog and the cat, he tells us, showed a general appreciation of what was to be done, for they became excited when preparations were made for a fresh experiment, even if it was of a new kind. Speaking of another dog, Mr. Hobhouse says: 'but apparently she was guided by what in the human being we should call common sense,' an opinion which of itself suffices to show that though conservative, he does not belong to the extreme agnostic school of comparative psychology. On p. 222 of his book, Mr. Hobhouse presents the following summary: "On the whole, then, it would seem that animals are influenced by similarity of relations. Not that they dissect out the common element which constitutes a class identity; they have not solved the problem which has baffled logicians; it is rather that they have a concrete perception of the man or animal, house or locality, with which they are familiar; that such an object contains many objects in various relations, and that when they meet another object, similar in general character, *i. e.*, really in its constitutive relations to the first, they know how to deal with it. This implies that they have the power of grasping an object as a whole, including distinct elements which I have called concrete experience, and the power of applying this experience, which I have called practical judgment." And again, he makes the following comprehensive statement, which is worth quoting in full: "However this may be, we have some ground for thinking that the more intelligent animals have a knowledge of surrounding objects which they apply in action; that they are capable of learning to act in accordance with physical changes which they witness; that they may be influenced by the general similarities which unite individuals of the same class, and can guide their action in dealing with any object by the relation in which it stands to that which they desire. Further, evidence has been brought that in the process by which they learn, not repetition of instance, but concentration of attention is the important point. Lastly, it is suggested that in some cases they not only

merely learn to meet a given perception with a certain motor reaction, but also to combine and adapt their actions so as to effect physical changes which, as they have learned, aid them in gaining their ends."

"We have thus gone over all the points enumerated on p. 134, as descriptive of concrete experience and practical judgment, and have seen some ground for imputing each and all to the higher animals. At no point, perhaps, is the evidence conclusive, but it is to be remembered that these functions are indicated so that evidence of capacity for one is indirect evidence of capacity for another. We have, therefore, a set of independent arguments all pointing in the same direction, and it is on this convergence of evidence rather than on decisive proof at any point, that our hypothesis must rest."

But little credit has been given to animals by the laborators for inhibition or self-restraint. Their experiments were not calculated to bring this quality into bold relief—quite the contrary. Such experiments often tend to cause mental disorder, so that one is not observing the animal at its best, but at its worst. Mr. Hobhouse, however, has not wholly neglected this subject, for he remarks that "the self-restraint of the pointer is the result of severe training, but we must not regard it as the result of mere blind habit superseding blind impulse, for, as Diezel remarks, the same dog who will refrain from following a hare in his master's presence will eagerly chase it if unobserved. The impulse is not instinct, but is controlled by the knowledge of results."

This subject is another on which fruitful work might be done; and here again one finds the greatest difference between individual animals as also between individual men. The difficulties in carrying out experiments on monkeys, because of their restlessness, are great, and Dr. Thorndike and Mr. Kinnaman deserve great credit for their perseverance, though I must say I should not have expected the most satisfactory results from some of their tests. Dr. Thorndike points out that the monkeys represent progress in mental development from the generalized mammalian type towards man in several directions, as in their sensory and motor equipment, but he is inclined, in accordance with his views of animal intelligence and psychology generally, to make all things pivot on the association process. He says, "Let us not wonder at the comparative absence of free ideas in the monkeys, much less at the absence of inferences or concepts. Let us not wonder that the only demonstrable intellectual advance of the monkeys over the mammals in general is the change from the few narrowly confined practical associations to an amplitude of all sorts, for that may turn out to be at the bottom the only demonstrable advance of man, an advance which in connection with the brain acting with increased delicacy and irritability brings in its train the functions which mark off human mentality from that of all other animals." And in his paper on the 'Evolution of the Human Intellect,' he expresses the opinion that the "Intellectual evaluation of the race consists in the increase of the number, delicacy, complexity, prominence and speed-formation of such associations. In man this increase reaches such a point that apparently a new type of mind results which conceals the real continuity of the process."

I can not but think myself that this is only a small part, a mere chapter of the whole story, and that by believing this to be the whole we retard progress. I wish to point out, however, that there does not seem to be the same objection to the methods of the laborators when applied to lower vertebrates. Dr. Thorndike's own studies on

a fish, *Fundulus*, with a low type of brain; the investigation of Yerkes and Bosworth on the cray-fish; that of Yerkes on the turtle; those on birds by various observers; and others to which the limitations of time do not permit me to allude seem to be in the right direction; all the more as in the case of fishes, turtles and other aquatic creatures ordinary observations must, in the nature of the case, be very restricted. We should surely expect that simple association processes would play a larger part in the psychic life of such creatures than in that of mammals. But when it is urged that 'association processes' with instinct explain all, or practically all, in the mental make-up of animals, I must enter a most vigorous protest.

Mr. Kinnaman is not sure, as a consequence of his investigations on the monkey, and as Dr. Thorndike believes, that they have no 'free ideas'—to use the terminology of the latter, and expresses his views regarding the monkey and animals generally, as follows: "Whether these animals have 'free ideas' and general notions beyond the mere 'recept' and are capable of real analogical reasoning, can not be positively determined. If they do the processes certainly do not rise to the level of full reflex consciousness. Yet there is no way of knowing, because there is no certain way of having the consciousness that the animal has. But that these monkeys have often acted objectively just as human beings act when they have these mental activities is most certain. I am inclined to believe that the human and animal consciousness are not really different in kind, but only in degree; the difference in degree, however, is very great." Mr. Hobhouse believes that there come points in growth where change of degree becomes change of kind, and refers to the fact that water may become vapor or ice according to the rate of vibration of the constituent molecules. However, analogies are proverbially dangerous.

With this writer's other views on the relation of human and animal intelligence as expressed in the following words, I find myself in accord: "Human intelligence develops out of a lower form by growth in this feature of comprehension on the one hand, and articulateness on the other, by which the higher stage of animal intelligence was marked off from the lower. Mind, it is suggested, differs from mind in the degree in which these powers are developed, in the experience which it can comprehend and in the articulateness with which it can comprehend it."

A noteworthy recent contribution to our subject is the address of Professor C. S. Minot to the American Association for the Advancement of Science on, 'The Problem of Consciousness in its Biological Aspects,' from which it appears that the professed psychologists are not doing all the thinking on psychology or philosophy. His general attitude may be understood from the following passage: "We must look to biologists for the mighty generalizations to come rather than to the philosophers, because great new thoughts are generated more by the accumulation of observations than by deep meditation. To know, observe. Observe more and more and in the end you will know. A generalization is a mountain of observations; from the summit the outlook is broad; the great observers climb to the outlook while the mere thinker struggles to imagine it. The best that can be achieved by sheer thinking on the data of ordinary human experience, we have already as our glorious inheritance. The principal contribution of science to human progress is the recognition of the value of accumulating data which are found outside of ordinary human experience." Minot's cardinal principle is thus expressed: "The function of consciousness is to dislocate in time the reactions from sensations."

"Conscious inhibition is thus distinct from reflex action; the potential reaction may, however, be stored up and effect future conduct. Consciousness has a selective power manifest both in choosing from sensations received at the same time and in combining sensations received at different times. It may make synchronous impressions dysynchronous in their effects and dysynchronous impressions synchronous, which statement is but a paraphrase of the original—the function of consciousness is to dislocate in time the reactions from the sensations."

"Our eyes, ears, taste, etc., are available because they supply consciousness with data. Our nerves, muscles, bones, etc., are available because they enable consciousness to effect the needed reactions." His view of animal consciousness is thus forcibly expressed: "The conception of homology, both of structure and of function, lies at the base of all biological science, which must be and remain incomprehensible to any mind not thoroughly imbued with this conception. Unless those who are deficient in this respect can fail to understand that the evidence is overwhelming that animals have a consciousness homologous with the human consciousness, the proof is conclusive. As regards at least mammals—I think we can safely say as regards vertebrates—the proof is the whole sum of our knowledge of the structure, functions and life of these animals. As we descend the animal scale to lower animals there is no break and, therefore, no point in the descent where we can say here animal consciousness ends and animals below are without it. It seems inevitable therefore to admit that consciousness extends far down through the animal kingdom, certainly at least as far down as there are animals with sense organs, or even the most rudimentary nervous system. It is unsatisfactory to rely chiefly on the anatomical evidence for the answer to our query. We await eagerly the results from psychological experiments on the lower vertebrates. A sense organ, however, implies consciousness, and since such organs occur among cœlenterates, we are ready to assign consciousness to these animals."

"The series of considerations which we have had before us lead directly to the conclusion that the development and improvement of consciousness has been the most important, really the dominating factor in the evolution of the animal series."

Minot is of those who would not deny consciousness absolutely to even vegetable organisms, for he says: "A frank unbiased study of consciousness must convince every biologist that it is one of the fundamental phenomena of at least animal life, if not, as is quite possible, of all life."

On adjustment and communication between individuals he thus expresses himself: "It is interesting to consider the evolution of adjustment to external reality in its broadest features. In the lowest animals the range of the possible adjustment is very limited. In them not only is a variety of possible actions small, but they cover also a small period of time. In animals which have acquired a higher organism the adjustments are more complex, both because the reactions are more varied, and because they cover a longer period of time. Thus the jelly fish depends upon such food as happens to come within its reach, seizing from moment to moment that which it encounters; but the lobster pursues its food, making complicated movements in order to reach and seize it. One can trap a lobster easily; I doubt if one can trap a jelly fish at all. The next great advance is marked by the establishment of communication between individuals of the same species. About this phenomenon we know exceedingly little; the investigation of it is one of the most important duties of

the comparative physiologist. Its bionomic value is obviously great, for it allows an individual to utilize the experience of another as well as its own. We might, indeed, compare it to the addition of a new sense, so greatly does it extend the sources of information. The communication between individuals is especially characteristic of vertebrates, and in the higher members of the subkingdom it plays a great rôle in aiding the work of consciousness. In man, owing to articulate speech, the factor of communication has acquired a maximum importance. The value of language, our principal medium of communication, lies in its aiding the adjustment of the individual and the race to external reality. Human evolution is the continuance of animal evolution, and in both the dominant factor has been the increase of the resources available for consciousness."

Professor Minot believes that consciousness is a real and dominant factor in the evolution of animals, that it affects the vital processes: "There is, in my opinion, no possibility of avoiding the conclusion that consciousness stands in immediate causal relation with physiological processes."

While I may not be ready forthwith to admit that Minot's dictum in regard to consciousness is perfectly satisfactory, it has been gratifying to me to find so many views similar to those which I have been myself accustomed for the past few years to elaborate in my lectures to students, expressed so clearly and vigorously in this address.

H. S. Jennings, who has worked much on the reactions of infusoria, after criticizing the conclusions of Hodge and Aikins, which he concludes go too far, refers to Minot's views. He thinks that by this writer's criterion we should clearly have to attribute consciousness to Stentor, for at times this creature inhibits reactions to stimuli, while again it reacts strongly. Jennings is not, however, satisfied with Minot's criterion, for he believes that 'Unconscious mechanisms can be constructed and, indeed, do exist, in which there is a dislocation in time between the action of an outer agent upon the machine and the reaction of the machine similar to what we find in organisms.'

I can do but scant justice to a highly critical, profound and suggestive paper by H. Heath Bawden on 'The Psychological Theory of Organic Evolution.' He passes in review the work of Binet, Cope, Loeb and others. Professor Loeb lays stress on what he terms 'associated memory,' by which he means, 'that mechanism by which a stimulus brings about not only the effects which its nature and the specific structure of the irritable organ calls for, but by which it brings about also the effects of other stimuli which formerly acted upon the organism almost or quite simultaneously with the stimulus in question.' Consciousness ceases with 'associated memory,' as in sleep, anæsthesia, etc. According to this test, Loeb fails to find consciousness in infusoria, cœlenterates and worms, and doubtfully in many higher forms. He is quite certain of consciousness only in many of the higher vertebrates. Bawden thinks Loeb errs, and while he believes that this criterion may be good for determining the *degree* of mammalian consciousness, he believes it too restricted to apply to the whole animal kingdom, much less to the plant world. Romanes held that 'consciousness was that which enables the organism to learn to make new adjustments or to modify old ones in accordance with the results of its own individual experience.' "Purposiveness means simple adaptation of means to ends; consciousness means the ability to vary the use of means to an end. The former may be quite automatic, the latter alone must be conscious" (Bawden).

Baldwin says, "Consciousness is the new

thing in nature, the thing which organisms show in all cases, their latest and finest adjustment and the central fact of consciousness, its prime instrument, its selective agent, its seizing, grasping, relating, assimilating, apperceiving—in short, its accommodating element and process—is attention."

Probably in no direction has more solid advance been made within the last ten years than in the psychology of instinct, impulse, habit and kindred subjects. Professor Lloyd Morgan's best contributions have been in this realm. In this he has been both the observer and the thinker, and his biological training has been at once a preparation for the task and a ground of confidence for the reader of his works. His 'Habit and Instinct' embodies much of the best that has been attained in that department. He, however, wisely draws on the stores of others and in these subjects the data are more abundant and reliable probably than in any other department of the whole field. The investigations of the Peckhams on insects deserve in this connection special mention. All agree that it is here that man and the animals stand on common ground. There is scarcely a prominent writer on human psychology who has not treated at greater or less length of the subject of impulse, instinct and habit. However, a great field is yet open, notwithstanding all that has been done, including such bold attempts as that of Professor Baldwin and others, to determine the sphere of these fundamental activities in the course of organic evolution in general.

The limitations of this address will not permit of extended reference to this subject, in which some of the best work of the last decade has been done. But at least a word must be said of the investigations of Professor Groos, whose books on the play of animals and play in the human being are mines of learning and full of suggestive, highly interesting and generally valuable information. Mr. H. R. Marshall has also quite recently devoted an entire work to the subject of 'Instinct and Reason.'

It seems to me that development in this subject has been retarded by an inadequate appreciation of what I conceive to be of the greatest moment: that the qualifications of the investigator are of quite as much importance as the method, probably a great deal more. Professor Groos has thus referred to the equipment of the individual who would study animals in one of their aspects: 'The author of the psychology of animal play should have in reality, not alone two but many souls within his breast.' He would have him combine with all the varied ideas and experiences of a man who has traversed the round globe, the special knowledge of the director of a zoological garden, and also that of him who has penetrated the life secrets of the forest, and who can moreover take the point of view of a student of æsthetics. If these are the qualifications for a special investigation of animal play, they are surely not less called for in the other realms of comparative psychology. However, many who are not qualified to do the highest kind of work in this department of investigation can, if they will, make contributions of accurate observations; but they must be slow to draw conclusions and have a saving modesty which can hardly be claimed as the most distinctive characteristic of the present-day investigator, but which so often caused Charles Darwin to pause.

To more than one has it seemed desirable that some correlation between the animal and the human mind should be attempted, and this could be best done by comparing the former with the human within a relatively short time after birth. Already a goodly store of material is available, but

special child study to this end is one of the needs of the hour.

SUMMARY.

The evolution of comparative psychology has followed in the main the evolution of biology and of psychology, and the general trend of human thought.

When man's mental attitude toward nature in general changed, animals also were regarded in a new light.

Until comparatively recently the contributions to the subject have been characterized by many-sidedness, but at the same time by looseness and often inaccuracy, with a tendency to undue credulity and anthropomorphism.

The 'experiments' of the laboratory school of comparative psychology have been chiefly valuable in their negative and indirect results. A large proportion of the tests used thus far have been inadequate and often positively misleading; but they have also indicated the directions in which we need not hope to succeed, and suggested more fruitful methods. These experiments have shown that under even unfavorable conditions animals may form new mental associations with surprising rapidity.

The laboratory methods have proved themselves best adapted to the study of invertebrates and the lower vertebrates.

The most fruitful work thus far done has been the observation of the development of animals from birth upward by the consecutive or (fairly) continuous method, together with such experimentation as has been carried out under freer and more natural conditions generally than those under which the laborators worked.

It is important that similar observations and experiments be made on other of our domestic animals and especially on wild animals.

In all cases the investigator should be, if possible, a man with a knowledge of animal life in general, and a special knowledge of the animals to be subjected to critical observation; and if he can combine this with a scientific acquaintance with both biology and psychology, so much the better. The sooner it is realized that the man is as important as the method, the better for the development of comparative psychology.

Much light is likely to come to comparative psychology from judicious child study, and it is important that both biologists and psychologists turn towards it and if possible work in concert in dealing with so large a field as comparative psychology.

Wesley Mills.

McGill University.

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## SCIENTIFIC BOOKS.

*British Museum (Natural History). Second Report on Economic Zoology.* By FRED. V. THEOBALD, M.A.

The author, who is vice-principal and zoologist of the Southeastern Agricultural College, and lecturer on economic entomology to Swanley Horticultural College, in England, has carried on the whole of this work, and drawn up the report as printed. It contains a large part of the information furnished by the director, Professor E. Ray Lankester, to the board of agriculture and fisheries, between November, 1902, and November, 1903, besides the replies given by the zoological department to other correspondents in connection with economic zoology, as well as special notes and some longer papers dealing with the subject. This makes a volume of nearly 200 pages of preeminently economic literature, relating to subjects of the utmost importance to the husbandman, not only in England, but throughout the British colonies as well. It is a very creditable report, from both the practical and the scientific point of view, and exhibits on the part of both author and director a sincere desire to enlarge its usefulness. This is witnessed by a number of cases where Mr. Theobald has been able to make some personal investigations and experiments, the results of which are given and serve to add materially to the economic value of the volume. It will prove of interest to American entomologists in a number of ways, as subjects of applied entomology in British colonies overlap similar subjects of investigation in the United States. Thus the Mexican cotton-boll weevil, cotton-boll worm, American fowl tick (*Argas americanus* Packard), Mediterranean flour moth, pear midge, wooly aphis (which our British cousins term the American blight) pea weevil, hog louse, sheep scab, cabbage root-fly, larch and spruce aphis, willow scale, ox warble fly, liver fluke in sheep, rose aphis, grain weevil, and the sheep nasal fly are all of them cosmopolitan pests, and anything pertaining to them is of equally general interest, and all receive attention in this report, together with suggestions for the best means of prevention or extermination.

Mr. Theobald has been able to experiment with arsenate of lead for codling moth, and found that it is as effective in England as it is in America; besides he has found that while fruit growers can not combine Paris green, Bordeaux mixture and paraffin emulsion, they can do so with arsenate of lead substituted for Paris green, and besides combine with quassia washes, thus securing a wash that will combine two chief insecticides and a fungicide.

The introduction of beneficial lady beetles comes in for its share of attention, and there is much encouragement in reading of the inquiries that have been received from not only hop growers but fruit growers. Surely, if some of the aphis-eating lady beetles that the writer observed in the gardens about Hobart, Tasmania, a number of years ago, feeding on these insects, could be colonized in the United States, there might be considerable benefit derived from them, and there is no reason to suppose that the results would differ in England.

While not of vital importance to the American entomologist or fruit grower, it is inter-

esting to know that some of the ground beetles attack the ripening strawberries in England, precisely as do similar insects with us, and it is especially interesting to learn that good results have been obtained by sinking small 'pudding-basins' in the soil between the rows of strawberries and baiting the beetles with lights and sugar water. It is also of interest to us to know that *Byturus tomentosus* attacks the raspberry in England precisely as does its congener, *B. unicolor*, in America.

The volume gives every promise of meeting a demand among the agricultural classes for just this sort of helpful literature, but since it was received we have been surprised and pained to learn that continuance has been made impossible from the fact that the Royal Board of Agriculture has refused to grant funds for publication of future volumes.

When we recall that, for almost a quarter of a century, the late Miss Eleanor A. Ormerod carried on this work and published annually her valuable and painstaking reports, all at her own private expense, from which this board of agriculture made constant and copious abstracts, not always with too scrupulous credit, and now this same body refuses to contribute the mere pittance to enable Professor Lankester and Mr. Theobald to continue the work, we are forced to admit that our British (no, English) cousins have some characteristics that we find it hard to comprehend. However, the apple growers of the United States, Canada and Tasmania, who keep up with the times, will doubtless continue to furnish England with apples at profitable prices, and, as they jingle good British gold in their pockets, they will mentally smile at the little bigness of the Royal Board of Agriculture, which body seems inclined to further assist by a continuation of the conditions most favorable for future commercial transactions in fruit, etc., between these countries and England. F. M. Webster.

## SOCIETIES AND ACADEMIES.

### THE CHEMICAL SOCIETY OF WASHINGTON.

A special meeting of the Chemical Society of Washington was held on Wednesday April 6, 1904, at eight o'clock P.M. in the chemical lecture hall of the Columbian University. The meeting was addressed by Dr. Charles Baskerville, of the University of North Carolina, who after being introduced by the president spoke upon the following subjects:

Geo. F. Kunz and Charles Baskerville: 'Kunzite and its Unique Properties.'

Chas. Baskerville and L. B. Lockhart: 'Cause of Radio-activity.'

Chas. Baskerville: 'Thorium, Carolinium, Berzelium.'

The speaker exhibited specimens of kunzite and described some of its peculiar properties. In regard to the cause of radioactivity he called especial attention to the observation that all minerals which have the property of becoming phosphorescent under the action of radium rays, contain the element helium. The possibility was suggested that there is a relationship between the emanations of radioactive bodies and helium. In regard to the last subject on the program the speaker entered into greater detail, from both the historical and the experimental side of the question. He described the work which has occupied the attention of himself and a large number of assistants for the past ten years.

At the conclusion of the address some experiments were shown and specimens of radium of different degrees of activity were exhibited.

The 150th regular meeting of the Chemical Society of Washington was held Thursday evening, April 14, 1904, in the assembly hall of the Cosmos Club.

The first paper on the program, entitled 'The Feldspars—The Relation between their Composition and Certain Physical Properties,' was presented by Dr. E. T. Allen. An abstract of this paper has already been furnished Science for publication.

The second paper on the program, entitled 'Solubility of Gypsum in Solutions of Potassium Sulphate and Sodium Sulphate,' by F. K. Cameron and J. F. Breazeale, was presented by Dr. Cameron. The authors showed that at 25° C. with increasing concentration of potassium sulphate the solubility of calcium sulphate at first falls from 2.126 gms. $CaSO_4$

per liter to about 1.42 gms. $CaSO_4$ per liter in a solution containing about 15 gms. $K_2SO_4$ per liter, and then gradually rises to 1.585 gms. per liter in a solution containing 32 gms. $K_2SO_4$ per liter. This latter point is a triple point where a new solid phase syngenite ($CaSO_4 \cdot K_2SO_4 \cdot H_2O$) separates. As the concentration with respect to potassium sulphate still increases, no gypsum remains as solid phase but only syngenite, the amount of calcium sulphate in solution steadily decreasing. The solubility curves were determined, starting both with gypsum and with syngenite, good agreements being obtained. The position of the triple point was redetermined by the authors by using the procedure of van't Hoff and Wilson who had found a somewhat higher concentration with respect to calcium sulphate. The results confirm those obtained by extrapolation on the solubility curve. The solubility curve for calcium sulphate and sodium sulphate previously determined at 25° C. by Cameron and Seidell was confirmed. It is similar to the calcium sulphate, potassium sulphate curve, but there is no separation of a double salt at the temperature employed.

The last paper on the program, entitled 'Ammonium Chloride as a Reagent for Indicating Dissociation,' was presented by Dr. Peter Fireman.

In a former communication the author showed that when antimony pentachloride and ammonium chloride are heated in a sealed tube they act upon one another according to this equation:

$$3SbCl_5 + 2NH_4Cl = 3SbCl_3 + 8HCl + N_2,$$

while tin tetrachloride and titanium tetrachloride remain unchanged when similarly treated with sal ammoniac. The different behavior of the chlorides was ascribed to the fact that antimonic chloride readily dissociates on heating while the other two metallic chlorides do not.

In his new communication he gave the results of experiments by which he tested the validity of this explanation. The hypothesis was fully corroborated. He found that ferric chloride and cupric chloride which are known to dissociate behave like antimonic chloride, the reaction being:

$$3FeCl_3 + NH_4Cl = 3FeCl_2 + 4HCl + N$$

and

$$3CuCl_2 + NH_4Cl = 3CuCl + 4HCl + N,$$

while mercuric chloride, a non-dissociating halide remains unchanged like stannic chloride or titanium tetrachloride.

A. SEIDELL,
*Secretary.*

### THE SCIENCE CLUB OF THE UNIVERSITY OF MISSISSIPPI.

THE regular monthly meeting of the club was held April 15, 1904, in the chemical lecture room. The leader for the evening, Professor R. W. Jones, presented 'Some Thoughts in Reference to the Water Supplies of Mississippi.' A brief account of the history of water analysis was given, showing that, while in earlier years stress was laid upon the mineral ingredients, to-day the emphasis is placed upon the organic and sanitary analyses. In passing, the fact was noted that the value of mineral springs had long been greatly exaggerated. The Michigan standard of the purity of drinking water was discussed by the lecturer. The speaker then called attention to some interesting and valuable results of his own analyses of water from deep wells, artesian wells and streams throughout the state. Special reference was made to the geological formations of the middle-eastern section of the state, affording four different water-horizons, each yielding water of excellent quality.

ALFRED HUME,
*Secretary.*

### THE SCIENCE CLUB OF UNIVERSITY OF WISCONSIN.

THE sixth meeting of the club for the year was held Tuesday, March 22, in the physical lecture room of Science Hall. The first paper of the evening was by R. A. Harper on 'The Organization of the Cell as shown in Certain Mildews.' The paper discussed the development of the fruiting bodies of certain mildews from the standpoint of the structure and behavior of their nuclei in both fusing and dividing cells. A permanent polar organization of the nucleus and continuous connection of chromation and central body are found in these fungi.

The second paper, by A. H. Taylor, on 'Resonance in Aerial Systems,' was a discussion by the author of some recent advances in wireless telegraphy; it was illustrated and showed the fourfold tuning necessary for the transmission of large amounts of energy. The sender, the two aerials and the receiver were successively attuned, enough energy being transmitted several meters to light three small incandescent lamps.

Victor Lenher,
*Secretary.*

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA.

The 154th meeting was held in the Physics Lecture Room, Tuesday evening, April 12. The following papers were presented:

Professor C. L. Raper: 'The World's Production and Consumption of Coal.'

Professor H. V. Wilson: 'Grafting in Vertebrate Embryos.'

Professor R. H. Whitehead: 'Protozoa in Smallpox.'

A. S. Wheeler,
*Recording Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### SCIENCE, NATURE AND CRITICISM.

There appeared in a recent number of Science a somewhat unscientifically savage attack upon William J. Long and his books by Mr. William Morton Wheeler. The attack, which was ostensibly made on scientific grounds, was speedily followed by another and more personal one, written by Mr. Frank M. Chapman, and by a third by Mr. W. F. Ganong, who, on the principle that 'any stick will do to beat a dog with,' sent in an old criticism that was first published and answered in a St. John newspaper. The first object of the present article is to examine these attacks, and see what truth underlies them.

Very obviously there are two questions here, a question of animals and a question of animus. With the latter we have nothing whatever to do, except to deplore it. The original *Atlantic* attack upon the books in question, which was quoted and commended, can hardly be regarded as scientific, so far as this means a calm, dispassionate sifting of facts and evidence; and the writers, in following their leader, have been, perhaps, too much influenced by the great Frenchman's maxim that 'among wolves one must howl a little.' But, laying all that aside, the readers of Science have undoubtedly asked, how much truth is there in these animal stories, which have not only been called in question but have been denounced as falsehoods and inventions?

I take the most incredible of all, the case of the woodcock that set his broken leg in a clay cast, which was ridiculed by Mr. Wheeler in Science of February 26. Now, forgetting all the ridicule and misrepresentation and facetiousness of the article, what evidence have we for believing the story as recorded? For myself, having seen the incident, it has passed beyond the realm of opinion or belief into the realm of fact. Nevertheless, I pass over this, and also over the strong supplementary testimony of my friend, who might be considered as partial, to submit other evidence of which there can be no reasonable doubt as to its truth or disinterestedness.

Soon after the surgery article first appeared in *The Outlook,* the editors of that magazine received a letter from a lady in Galion, Ohio, who told of finding a woodcock that had set its broken leg in a clay cast in a way precisely similar to that recorded in the article on 'Animal Surgery.' When the attack of Mr. Wheeler, in Science, was called to my attention, I wrote to the lady, asking her to send me any supplementary details of her observation and the names of any other reputable people who might know of the circumstances. Here is the result—and I have submitted all documents and letters to the editor of Science that there may be no question as to their genuineness:

*My dear Dr. Long:*

The circumstances in regard to the woodcock are just as my father writes (see following letter), but I send a few facts in addition to those he has given. A short time before my father shot the bird we had read that the woodcock can put its own leg into a clay cast, but this hardly seemed credible. I was cleaning the game and had cut off the legs of the woodcock before I noticed that one leg had upon it a lump of dried mud. Immediately what I had read flashed through my

mind, and I saved the leg. * * * It was exhibited by my father to several physicians in town and all admitted it to be a broken leg perfectly mended by the bird itself. Dr. C. L. Coyle and Dr. H. R. Kelley (both deceased, but both well known and reputable physicians) exhibited this curiosity, one at a meeting of Galion physicians, the other at a meeting of the Crawford County Medical Society. No one denied or doubted in any way that it was what we thought it to be. * * * (Signed) Rena Reese.

Galion, Ohio, April 4, 1904.

Dr. Wm. J. Long,

*Dear Sir:* I have been in business in this place for the past thirty-two years. During this time I have always spent a few days yearly in hunting the different game birds in their various seasons. One day, a number of years ago, when hunting woodcock, I shot one which had evidently broken its leg above the knee joint. There was a bandage around it, composed of a hard clay-like substance, interwoven with grass or a woody fiber of some kind. The bone seemed to have been set properly and had knit perfectly. The natural swelling was nearly all gone; the bandage was loose and in my opinion would soon have dropped off.

I gave the leg, with the bandage on it, to one of our leading physicians and surgeons. He upon examining it expressed himself in a very emphatic way by saying that it was a better job than nine tenths of the surgeons could do. Dr. Coyle kept the leg at his office and later exhibited it at a convention of the physicians and surgeons of this country. After his death it was again exhibited at a meeting of the physicians of this city. Much interest was manifested in this curiosity, the like of which had never been seen by any one here, though some had read of such a thing.

(Signed) S. M. Reese.

* * * I carefully examined the specimen referred to, and can verify the statements of Miss Reese in every particular.

(Signed) F. L. Brown, M.D.

* * * A number of years ago there was exhibited in my place of business (apothecaries) the leg of a woodcock, which had been broken, and which plainly showed, by the clay and fiber entwined about it, that it had been dressed by the bird itself. * * *

(Signed) L. K. Reisinger.

Here is another case from a different state. I quote from the sworn statement of Mr. David E. Smith, of Bridgeport, who until a short time ago, when the sale of game became unlawful in this state, was engaged in the business of buying and selling game birds for the market, in connection with his regular business as a gun- and locksmith.

* * * Almost eighteen years ago Mr. Thomas Finn, a member of the police force of Bridgeport and who was accustomed to hunting game birds in season, brought to me the leg of a woodcock which he had shot. About midway between the foot and knee there was a clay cast in which some small feathers of the bird and some grass had been interwoven, apparently to make it more adhesive. This cast around the leg was a little over one half inch in length and about as large as an ordinary lead pencil. This leg of the woodcock was on exhibition at my store for a long period of time.

About eight years ago Mr. George W. Hayes, a well-known sportsman of this city, brought me the leg of a woodcock he had shot, and it presented an appearance substantially the same as the one above described. I opened the clay cast * * * and found that the leg had been broken. I exhibited this leg, with the part of the cast that I had not detached, to several persons in this city.

Since then I have seen another woodcock's leg that had been cut off by another sportsman presenting the same conditions; and four years ago, in a purchase of birds for re-sale, I found that one of the woodcock had a clay cast on one of its legs similar to the other three that had come under my observation. I exhibited this leg with its clay cast in my show window for two years, and a great many persons in Bridgeport saw it.

The cast was so constructed and so attached to the leg as to preclude any theory of accidental attachment; for in each case it was uniformly attached around the leg and fashioned in a way to indicate that it was attached for a purpose, and was in each instance made more effective by the interweaving of dry grasses or small bird's feathers. * * *

(Signed) David E. Smith.

Bridgeport, Conn., 23 April, 1904.

We, the undersigned, have seen in the possession of David E. Smith, on various occasions, a woodcock's leg with a clay cast surrounding the leg, presenting the appearance described in the foregoing affidavit. * * *

(Signed) William B. Tuttle,
Joseph H. Smith,
Wm. K. Wollan.

Personally appeared before me David E. Smith, William B. Tuttle, Joseph H. Smith and William K. Wollan, each of whom is personally known to me, and made oath to the truth of the foregoing statements.

(Signed) Stiles Judson, Jr.,
*Notary Public.*

Here is certainly warrant for believing not only that the woodcock sets his own broken leg, but also that the habit is more common and widespread than I supposed possible when I published my own observations. I have other letters and evidence from three different states bearing on the same question, and to the same effect; but these are probably enough. It may safely be left to the readers of Science to determine whether or not my story of the woodcock in 'A Little Brother to the Bear' is carried out, even to the smallest detail, by this disinterested evidence.

The second attack, by Mr. Chapman, is an extraordinary one for a man to make in the name of science. Starting with the assumption that, in the woodcock article and in all my books, I am falsifying and misrepresenting, he endeavors to account for it on the ground of personal characteristics. With calm and scientific judiciousness he omits the biographical dictionary and the testimony of all who know me, and fastens upon a newspaper clipping. That is generally regarded as rather poor scientific evidence; but even so, Mr. Chapman finds it 'illuminating,' and so let us examine it such as it is.

The *Transcript* article professes to be written by a friend of mine, an intimate acquaintance, who was a classmate at Andover Seminary, and who recounts certain occurrences in the class-room as an eye-witness. As a matter of fact, I do not know the man, and never saw him to my knowledge. He was never in the class-room with me, nor in the seminary during my three years' residence. The striking incident which he relates of me happened to another fellow, on the subject of Greek exegesis. He evidently got hold of it by some rumor, applied it to me, and touched it up with a vivid bit of personal recollection to brighten the effect.

A single bit of his testimony may be considered as typical of all the rest. He represents that I fitted myself for Harvard 'by solitary study,' and missed the supreme importance of freshman year; and, therefore, I have been ever since 'easily tempted to overrate my personal knowledge.' The facts are, that I graduated from the classical course in a good high school, which still regularly fits for college; that I took the full four years' course, classical and scientific, at the Bridgewater Normal School, which required an enormous amount of class work; then followed the Harvard degree, and Andover Theological Seminary, and three years in foreign universities, for all of which I have parchments to show that the work was regular and well done. I have undoubtedly seen more 'solitary study' and midnight oil than is good for a man; but, so far as there is any saving grace in class work and professors and in rubbing elbows with better men, I have had rather more than my share of the covenanted as well as of the uncovenanted mercies of our educational system.

All the rest of the statements are of the same kind. They are, almost without exception, errors, or misrepresentations, or pure inventions.

So these 'illuminating paragraphs,' upon which Mr. Chapman lays such emphasis, are illuminating chiefly in showing the enormous presumption with which a man will rush into print and join in a controversy of which he knows nothing. Incidentally, they may shed a little light upon Mr. Chapman's scientific way of collecting evidence.

As for the observations upon which he throws discredit, if he will read the books he will see instantly that he has misrepresented half the cases which he cites so carelessly. As for the others, the crows that played a game with a china ring, the porcupine that rolled down hill, the ducks that drowned mussels in fresh water—for these, and for every other observation which he discredits, I have more written evidence and more oral testimony from reliable observers than for the woodcock, which has just been considered. If scientists and comparative-psychologists are honestly looking for new facts in the animal world, I have enough to fill several reg-

ular editions of Science, every one of which is supported not only by my own personal observation, but by the testimony of other honest men whose word can be taken without hesitation.

The question naturally arises, and has indeed been asked with some irritation, why, with all these facts at hand, a man does not write as a scientist and produce his evidence. The answer is threefold: (1) I am accustomed to be believed when I speak. Knowing my subject, and with the evidence of my own eyes before me, it has hardly seemed necessary, for the sake of a few critics who will not believe, to refer to supplementary evidence, of which I have a plenty; to 'cross my throat,' boy fashion, as an evidence of sincerity, and to state after every observation: Mr. So-and-so saw the same thing in Such-a-place; if you don't believe it, ask him. (2) I have gone into the outdoor world as a nature lover, not as a scientist; for recreation, not for work; and my aim, as that of other nature writers, is chiefly to influence other people to go out of doors themselves, and by telling the whole truth, so far as I can see it, to open their eyes to the facts of animal life which the scientist, as well as the vacationist, has overlooked, under the supposition that birds and animals are governed solely by instinct and reflex impulses. And (3) while the scientist deals with laws and generalizations and works largely with species, I have dealt always with individuals, and have tried to understand every animal from moose to woodmouse that I have met in the wilderness.

That birds and animals (and even the insects, especially the solitary wasps and spiders) differ greatly among themselves in individual characteristics and habits, is now beyond a question. Sooner or later science will collect these individual differences and go to work upon new laws and generalizations; but at the present moment when one goes into animal individuality he crosses the borderland of science into a realm where our present laws and classifications apply only in the most general way. Every animal he studies closely is different from every other animal, for nature seems to abhor repetition as she abhors a vacuum. As among men, the differences, which lie deep are much harder to detect than the resemblances, which are mostly on the surface. All the men of a city street are alike from a third-story window, which is nearer than we generally get to wild animals. There are even women who declare that the generalization holds true at a closer inspection —but that is another matter. Two men in dress suits will pass the same general social muster at a dance or reception, and may be indistinguishable across a small room; but it will take some intimate acquaintance to discover that they are as far apart as Beelzebub and Gabriel. And any one who has ever learned to know intimately a litter of pups or a litter of fox cubs will recognize instantly that the same differences in character and disposition which prevail among men prevail also, though in less degree, among the beasts of the field, and are the last things to be discovered.

Though the field is an immense one, and practically unknown so far as wild animals are concerned, there are as yet only a few pioneers scattered over it. The facts are plenty enough, but the observers who have the patience and sympathy for the work are very few, and it will be years before they make any impression upon our general ignorance about birds and animals. It must be said also, of the nature students as distinct from the scientists, that they go into the field for pure love of it, rather than from any desire to make a book, or a theory, or to be enrolled among the discoverers of science. The element of personal taste also is a factor against them; they hate to kill and destroy, to stuff and label and put into a museum.

The ornithologists, for instance—and I have known many of them intimately—have been busy for years making collections of nests and eggs and bird skins; they have determined the range and distribution of species fairly accurately, and have gathered much interesting information as to food and breeding places of our native birds. These are the acknowledged 'scientists' of the bird world; and we have watched their work with interest, though at times with regret at the enormous and un-

necessary amount of killing which generally accompanies their investigation. They deal with species and general habits, and their work, so far, covers little more than the surface of bird life. Meanwhile the individual bird, with his own thoughts and feelings, his own life to live and his own problems to solve, has remained almost unknown till a few nature lovers and students entered the field and, leaving behind the gun and the egg-case and the 'identification of species' as the one thing to seek after, have hidden and watched and followed and loved the bird, and have understood exactly in proportion as they have loved him. The derisive cry of 'interested observer' raised against them by certain professed scientists has no reasonable foundation. No man watches and no man records in any field except he be interested. His observations are valuable exactly in proportion as love impels him to find out about things. Scientist and nature student are both seeking truth, and finding the particular manifestations of truth that they seek after. The difference is something like this, that the ornithologist loves specimens and the identification of species and other superficial things, while the nature student loves birds and the life that is akin to our own. The latter may prove, in the end, to be more scientific than the former.

At present the nature student is simply trying, without prejudice, to understand and record life as he sees it, and asks no scientific consideration beyond that suggested by common honesty and courtesy. When his record is written, his facts may be collected, and the comparative-psychologist, who now knows almost nothing of the life of the wild bird or animal, will then be able to finish the work which the ornithologist only began. Not till then shall we have anything like an edequate picture of bird life; and till then it may be well for critics to remember that truth is a large proposition and, like honesty, is not subject to monopoly.

Since the above article was written, another attack in the same spirit has appeared in SCIENCE, by Mr. William Harper Davis, a psychologist, who adds the name of Columbia University to support his claims. My first care, after reading the long article carefully, is to cut out from it all the personal abuse, the gratuitous insults to myself and to certain literary men, the repeated sneers at an honored body of some millions of young people, the satire, the ridicule, the sophomoric egoisms and several other things which have no bearing on the subject in hand, and which ought not to have been permitted to appear in a magazine under the great name of SCIENCE. What remains of the article consists, as do the other criticisms, of a few paragraphs of dogmatic assertions, denials and accusations, without a shred of evidence to support them.

Two things, however, may be profitably considered by the readers of SCIENCE who have seen this new attack, which is extremely characteristic of all the others:

1. Mr. Davis assures us that his article has no personal or unworthy bias. 'No personal feeling of any sort whatever prompts or accompanies this letter,' he assures us. Now here are a few, out of many such, words and epithets which he applies to certain gentle books and their author, and which, since no personal feeling is involved, are supposed by this scientific critic to be purely scientific and impersonal descriptions: '*Sham, crass, crude, aimless, pitiful, preposterous, ludicrous, false, meretricious, unintelligible, distortions, prejudices, farce, abominations, menace, prostitution, hocus-pocus, ignorance, arrogance, erotic effusion, general incapacity, vicious notions, crass misrepresentations, hopeless confusion, inordinate gullibility, a facile fabricator, an influence for evil, chief of a tribe, hopeless romancer, incapable of reform, type of his species, intellectual anarchist, wild ass, a sad case*'—all these for me. And I pass over as irrelevant, '*nuisance, blatancies, bigotries* and *cocksureness*' as applied to popular education.

Such is the language of this 'impersonal' criticism by a scientist. One can not help wondering what would happen to the unfortunate man who should really stir Mr. Davis out of his scientific calm and cause him to write personalities. Certainly even the present language and style are somewhat different

from that to which we are accustomed in the scientific books and treatises of our acquaintance. In an ordinary person this would be called Billingsgate, and the feeling that produced it might be termed anger, irritation, jealousy, malice, envy, spite, or some other purely personal and unscientific stimuli. Since, however, he has no personal feelings in the matter, it might be well for him, being, as he tells us, a 'technical student of psychology,' to examine himself seriously in order to ascertain what extraordinary mental state it is which, without feelings, causes all the symptoms of intense nervous irritation, and which, in a normal scientist, causes him to write in such very unscientific language. We suspect he has mistaken his symptoms, and that he must revise either his language or his psychology.

2. The one specific case which Mr. Davis mentions and ridicules, and which has been derided also by Mr. Burroughs and one or two other critics of his kind, as showing nothing but my own 'gullibility,' is the case of the orioles' nest. In the case of the woodcock I have already given the kind of evidence which supplements my own personal observations, and which I can produce abundantly to verify every one of my published records of animal habits. The orioles' nest is a somewhat different matter, in that it is not the direct result of my own personal observation. I referred to the nest in a magazine article simply to illustrate, from another's observation, the unexpected recurrence of a rare phenomenon, such as an oriole's fastening two twigs together with a piece of twine, which I had once seen done. Since, however, some readers may have an honest question as to why I should accept such an unusual observation, I submit certain facts which, for obvious reasons, it hardly seemed necessary to publish at the time I referred to the nest in the *North American Review*.

I first noticed the nest hanging in a room where a man lay dying. It was a sad story —but that is no part of the evidence. The dying man was being cared for with infinite patience by a kindly workingman, who was no relation whatever. It was the latter who owned the nest, who had watched it building, and who told me about it, one day, noticing my unconscious interest. After the funeral it was given to me, unexpectedly, in gratitude for certain little kindnesses which I had been able to show to the family and to the dying man, who also knew all about the nest. Every circumstance in the case was such as to preclude any thought of deception, even had there been the slightest ground for such a thing.

The nest itself is, without a question, the work of orioles, and the only possible doubt can be in the matter of the framework. The sticks are not such as a man would choose, and the tree in which it hung is the very last that a man would select for hanging such a framework. It is a huge buttonwood, and no man or boy living could climb out on the slender branch to where the nest was hung. Only a ladder would be possible, and in the whole neighborhood of the nest there was not a ladder found long enough to reach it. When it was proposed to cut it down, in the autumn, an extra long ladder had to be brought from some masons who were repairing a chimney; and this had to be stood almost straight on end before it barely touched the branch. Two men were required to hold the long ladder in place while a third went up with difficulty to cut down the nest. If a man had made the framework for the birds' use, he would certainly, unless crazy, have hung it in a different tree and in a more accessible place. All these external facts, which I have verified myself, point to the whole marvelous structure as the work of birds alone.

At least four persons, two men and two women—all of them honest and trustworthy people—saw the nest at different stages of its construction, and when questioned, separately and unexpectedly, gave substantially the same testimony. I submit the sworn statement of the man beside whose house the nest was built, who watched the work of construction from beginning to end, and who cut down the nest after the birds had raised their young in it and flown away:

I certify that I watched, from beginning to end, the construction of the nest now hanging in Dr. Long's study, and described by him in the *North*

*American Review.* The nest and framework are wholly the work of the orioles themselves. They tied the three sticks together, with string, in the form of a triangle; they swung this triangle by means of cords below the limb of a buttonwood tree and fastened it there, and then built the nest on their own framework. Beyond the bits of thread and string which they collected about the house, they received no help from any human agency. (Signed) F. G. Leslie.

Stamford, Conn., 25 April, 1904.

Subscribed and sworn to before me this 25th day of April, 1904. E. L. Scofield,
*Notary Public.*

It is hardly necessary to add that we have here a simple question which can not be ridiculed by the cry of 'hunter's yarn' or 'practical joke,' or befogged by the call for expert testimony. It is not a question of instinct or intelligence or comparative psychology, or anything else to call for experts or trained observation. The question is, whether or not certain birds tied three sticks together and hung them unaided from the limb of a tree. That in itself is a sufficiently wonderful fact; and again I leave it to the readers of Science to say whether or not I was justified in accepting it as reasonable evidence.

Let us hear the conclusion of the whole matter. Here are certain books which, by almost universal consent, are doing good in the world. They arouse not only a love for animals, but an intelligent interest and, if the testimony of hundreds of educators is to be believed, a keen interest to study and understand the animal life about them. They are not stories, but studies, and incentives to study; and if unwittingly they contain any error, the error is bound to be swept away by the very interest in nature study which the books themselves arouse. And here, on the other hand, are a few critics, who, in the name and with the authority of science, condemn the books and warn an innocent public against being deceived by falsehood and inventions. Now what is the scientific explanation of this phenomenon? By scientific I mean simply that which will take into account the facts and, so far as possible, all the facts. The alleged facts brought forward in the criticisms which appeared in Science are seen to be dogmatic denials mixed with considerable error and misrepresentation. Here are certain other facts to be duly considered:

1. The books in question record hundreds of observations, the great majority of which are known to be true. The rest are unusual, and some, indeed, seem incredible. On the other hand, it may be said for the latter that we know very little of the lives of the animals described, and the most striking things recorded are no more incredible than scores of well-authenticated instances of the intelligence of dogs and cats and horses. The only question, therefore, is, can we safely attribute to the wild animal the same individuality that we see in our domestic one? In other words, are the wolf and fox less intelligent than the dog, the black duck less keen than the barnyard fowl, the wild turkey and the grouse of less wit than the chickens, the deer and mountain sheep less resourceful than domestic cattle?

2. The observations recorded in the books in question have been made by an experienced observer who has put himself with much care and patience in the position to see what he describes. It is possible that he has made honest mistakes in his observations; but, on the other hand, those facts which have been most denied, like the woodcock, have been verified by other observers.

3. The author studies the living animal in his native haunts and in every case writes from first-hand knowledge, after long experience and with unusual opportunities for observing the wild creatures. The critics, with far less experience or knowledge of the animals in question, and with different interests, deny the observations on general principles, or on the ground that they have not seen them.

4. The attacks which have been made thus far are mostly ill-tempered and intemperate, as far as possible from the scientific spirit which they invoke. Though written in the name of science, they show none of her careful, painstaking methods; though their professed object is truth, they do not verify their own statements nor prove their accusations. The attacks are generally made by men who have

themselves written less successful books or articles on the same general subject.

5. The critics present denials, dogmatic assertions, negative testimony. Not one particle of positive evidence has yet been presented against the books which are so vigorously condemned. Meanwhile the fact remains that, though six or seven volumes and a score of articles have already been published, only two slight errors have thus far been pointed out, and they were promptly and gratefully acknowledged.

Other facts and considerations will undoubtedly suggest themselves, but perhaps it were well to consider these first in forming one's judgment as to the books and their critics.

WM. J. LONG.

STAMFORD, CONN., May 7, 1904.

[We hope that this discussion will not be carried further.—EDITOR.]

### THE METRIC SYSTEM.

TO THE EDITOR OF SCIENCE: The suggestion of Professor W. Le Conte Stevens that a compromise be made between the metric and the British system of weights and measures, making a foot the fourth part of a meter and an inch two per cent. smaller than the British inch, might be a good one if the English-speaking race were to disappear from the earth, and all its tools and its technical literature be destroyed, but as long as that race continues to use its existing tools and books, so long must the inch persist with its present value. His article is useful, however, in showing the impossibility of the general adoption of the metric system in its present form by the people of this country. He well says: "What may be the form taken by legislation in England and the United States, the people can not be compelled to adopt nomenclature that is thrust upon them as a substitute for that to which they have always been accustomed."

WM. KENT.

### ICHTHYOLOGY IN THE 'ENCYCLOPÆDIA AMERICANA.'

TO THE EDITOR OF SCIENCE: Referring to Dr. Gill's note on the 'Ichthyology of the Encyclopædia Americana,' I may say that he is quite right in supposing that the proofs of the figures which illustrate my article on fishes were not submitted to the author. Many of these seem to be wrongly named as noted by Dr. Gill.

DAVID S. JORDAN.

## SPECIAL ARTICLES.

### THE MULTI-NIPPLED SHEEP OF BEINN BHREAGH.*

ON two former occasions† I have had the honor of presenting communications to the academy concerning the multi-nippled breed of sheep on my farm at Beinn Bhreagh, near the town of Baddeck, Nova Scotia.

It will be remembered that in 1889, upon the purchase of some property at Beinn Bhreagh I found myself in possession of a flock of sheep; and that in the spring of 1890, one half of the lambs born upon the place turned out to be twins.

This large percentage of twins led me to examine the mothers of all the lambs with the object of discovering, if possible, some peculiarity that would enable us to distinguish twin-bearing ewes from others.

Upon examining the milk-bags of the sheep a peculiarity was observed that was thought might be significant. Normally, sheep have only two nipples upon the milk-bag, but in the case of several of the sheep examined, supernumerary nipples were discovered which were embryonic in character and not in a functional condition. Some had three nipples in all, and some four. Of the normally nippled ewes 24 per cent. had twin lambs; but of the abnormally nippled 43 per cent. had twins. The total number of ewes, however, was so small (only 51) as to deprive the percentages of much significance. Still the figures were suggestive of a possible correlation between fertility and the presence of supernumerary nipples, and it seemed worth while to make an extended series of experiments to ascertain (1) whether, by selective breeding, the extra nipples could be developed so as to become functional, and (2) whether ewes possessing four functional nipples instead of two would

* A paper read before the National Academy of Sciences in Washington, D. C., April 21, 1904.

† See SCIENCE, Vol. IX., May 5, 1899, pp. 637.

turn out to be more fertile than other sheep and have a larger proportion of twins.

1. In regard to the first point mentioned no difficulty was experienced in developing the embryonic nipples into real functional mammæ yielding milk; and for several years past the ewes born on Beinn Bhreagh (with extremely few exceptions) have possessed four functional nipples.

Of recent years lambs possessing five and six nipples have appeared, and it is obvious that continued selective breeding would ultimately result in the production of a six-nippled variety of sheep.

How far the number of functional mammæ could be increased by selection it is of course impossible to predict; but it is worthy of note that one ewe has been born with four nipples on one side of the body and two on the other; and, as the supernumerary nipples have a tendency to appear in pairs, this probably foreshadows the possibility of an eight-nippled variety.

2. In regard to the second point mentioned the multi-nippled sheep have not proved to be more fertile than normally nippled sheep; and the proportion of twins born has been quite small.

One peculiarity, however, is worthy of notice: The twin lambs, though usually smaller at birth than single lambs, speedily come up to the average of the flock in this respect—so that by autumn there is no substantial difference in weight between the single and twin lambs. The multi-nippled sheep are, therefore, able to rear twins more successfully than normally nippled sheep.

This is an important point, and it suggests the advisability of attempting now—by the elimination of single lambs and the retention of twins for breeding purposes—to produce a twin-bearing stock.

At present the Beinn Bhreagh flock constitutes simply a scientific curiosity, and is of little practical value to the country. I propose to make it of value by engrafting upon it the twin-bearing tendency. In Nova Scotia the winters unfortunately are long, and the cost of winter feeding proportionally great, but the country is otherwise admirably adapted for sheep-raising upon a large scale. The production of a twin-bearing stock would do much to promote this important industry by enabling the farmers to make a double profit upon lambs without additional cost.

The proposed experiments, however, can not be made with a small flock, and the natural increase of the Beinn Bhreagh flock is so slow that many years would elapse before it would be practicable to carry out the plans proposed. I have sought to increase the size of the flock by the purchase of multi-nippled sheep from surrounding farms, but an examination of several thousand sheep has convinced me that it is no longer possible to purchase sheep having the characteristics of the Beinn Bhreagh flock to a useful degree. I, therefore, propose to purchase large numbers of ordinary two-nippled ewes and mate them with Beinn Bhreagh rams—segregating the present flock as much as possible. The multi-nippled lambs born to the normally nippled ewes will enable us to increase the size of the multi-nippled flock beyond its natural increase—and be otherwise beneficial by the introduction of new blood; but the new blood will probably be detrimental to the particular line of selection hitherto pursued and lead to a reduction in the percentage of multi-nippled offspring in that flock.

The present, therefore, seems to be a fitting time to place in the hands of those interested in evolutionary problems, a detailed account of the flock; and I have prepared for private circulation two pamphlets, one entitled 'Multi-Nippled Sheep of Beinn Bhreagh, Living 1903, and Their Known Ancestors,' the other 'Sheep Catalogue of Beinn Bhreagh, Showing the Origin of the Multi-Nippled Sheep of Beinn Bhreagh and Giving all the Descendants Down to 1903.' I have great pleasure in presenting the first copies of these pamphlets to members of the academy specially interested in the subject.

ALEXANDER GRAHAM BELL.

## *BOTANICAL NOTES.*

### POPULAR HELPS IN THE STUDY OF THE FUNGI.

IT is particularly gratifying to notice the efforts that Professor Kellerman, of the Ohio

State University, is making to help the teachers in the public schools of Ohio to a better understanding of the larger fungi. From time to time he issues a four-page folder under the name 'Mycological Bulletin,' consisting of a little text and a good deal of photographic representation of the species he is describing. We know of nothing like these leaflets elsewhere, and can not too heartily commend this method of popularizing the study of the fungi. When it is remembered that these bulletins cost the subscriber only about a cent apiece one wonders that the subscription list does not include every school teacher in Ohio, to say nothing of those outside of that fortunate state.

### FOREST FIRES IN THE ADIRONDACKS IN 1903.

THE United States Bureau of Forestry has issued a circular (No. 26) on the forest fires in the Adirondacks, from which we learn that 'between April 20 and June 8, 1903, over 600,000 acres of timber land in northern New York were burned over' with an estimated loss of $3,500,000. A very dry spring and 'culpable carelessness' were what brought about this great loss. 'Deliberate incendiarism' is charged with no small number of fires, while a few are due to unavoidable accident. The author of the circular says after careful examination that 'fully one half of the fires are due to carelessness caught from locomotives' of the railroads in the forests. It is known that a particular excursion train hauled by two locomotives set almost continuous fires for a distance of ten miles. The burning of brush and other débris, the carelessness of smokers, the failure to extinguish smudges and camp fires contributed to the grand total of carelessness. Many fires were set deliberately, in part by those who resent the formation of private preserves, partly by those who do not like the present timber regulations, partly by those who profit by the labor afforded by fire fighting, some by hunters, some by those who hope thereby to increase the berry crop, or the crop of ginseng, etc. A large map tells the story of destruction and loss better than it can be told by words. The circular should serve to awaken the public conscience, and should result in more effective legislation, and a better enforcement of existing laws.

### THE BACTERIOLOGICAL ANALYSIS OF SOILS.

A RECENT bulletin of the Delaware Experiment Station brings out an interesting relation of bacteria to the fertility of the soil. It has long been known that certain bacteria in the soil add to its available nitrogen for plant growth, and now Professor Chester has actually made bacteriological analyses of the soil for the purpose of determining the nitrifying efficiency of its bacteria. In soils containing respectively 4,000,000, 3,130,000 and 250,000 bacteria per gram of dry soil the nitrifying efficiencies were 26.68, 13.75 and 2.13. Professor Chester concludes 'that while zymotic efficiency is generally proportionate to the total number of bacteria present in soil, it is not exactly proportionate.' 'It is not only numbers of bacteria but also kinds which determine the efficiency of a soil.' Further on he says 'there is a possibility that the future will develop some practical means of introducing favorable bacterial forms into the soil, and thus of raising its bacterial potential.' Here is a field for the scientific agriculturist not thought of by our fathers, who, if they knew anything at all about bacteria, regarded them as vermin to be avoided as far as possible, and even now most of us think of 'germs' and 'microbes' as dangerous things to have about. Evidently we have done the tribe of the bacteria an injustice, for it looks as though our crops were dependent upon their presence in sufficient quantity in our fields. Is it possible that the farmer of the future may regularly inoculate his fields before planting to a particular crop? While all this is quite funny, Professor Chester has done a piece of good work, and it is to be hoped that he may have the time and inclination to continue it.

### THE STUDY OF OUR MOSSES.

ANY one who has attempted to take up the study of the mosses of his neighborhood must have been impressed with the feeling that there is a crying need of a work on the systematic botany of these pretty plants which

is usable by amateurs and other non-technical bryologists. The general botanist who wishes to know something about all kinds of plants has often felt that there is a needless technicality in the books devoted to the lower plants, and with the single exception of the lichens, the mosses have suffered most of all. Several years ago Professor Grout began work on the descriptive botany of the mosses with the intention of remedying this condition of things, and the result was a handy little elementary manual entitled 'Mosses with a Hand-Lens.' The success of this booklet has encouraged him to undertake a larger book, to which he gives the name 'Mosses with Hand-Lens and Microscope.' Of this, Part I. was published some time last year and was noticed in SCIENCE upon its appearance. Part II. is now in the press, and is to appear about the middle of May. An examination of advanced sheets shows that this is to be still better than the first part. With this book, when completed, the study of the mosses will be little more difficult than that of the flowering plants.

### SUMMER BOTANY.

THE seaside laboratories are tempting botanists to vacation work at Woods Hole, Cold Spring Harbor and Vancouver Island, with several more stations yet to be heard from. In the interior the Lakeside Laboratory at Cedar Point (near Sandusky), and the alpine laboratory on Pike's Peak offer to the inlander out-of-door recreation mingled with serious study. There should be little difficulty in determining where to go, in case one wants to get out into the air while at work. The sea always calls some of us, and the mountains too call us with a voice that we can not resist. Down by the sea we may study the strange and beautiful things that grow in the depths; on the mountain side we may study changes in vegetation due to altitude and low temperature. At the seaside we may bathe when we are warm and tired; on the mountain side we cool off in the thin air two miles above sea level, and rest under the fragrant Rocky Mountain pines and fir trees. Wherever we go we may do a little work—possibly a good piece of work; at any rate we may be refreshed physically and mentally, so as to return to our class-rooms and laboratories in September able to do better work there.

CHARLES E. BESSEY.

## *THE BIOLOGICAL LABORATORY OF THE BUREAU OF FISHERIES AT WOODS HOLE, MASS.*

THE laboratory will be thrown open on June 16, and will be at the service of a limited number of investigators, for the study of problems in marine biology, from that date until the middle of September. The occupant of a table will as usual be furnished with the ordinary apparatus and reagents and with material for research free of charge. Certain of the steam and other vessels of the bureau will be at the disposal of the laboratory, and systematic collecting will be in progress during the entire season. Candidates for laboratory privileges are advised to submit their applications as early as possible. Those who are not already known at the station will be expected to offer evidence of their qualifications. Applications should be sent to the director, Dr. F. B. Sumner, College of the City of New York, New York, N. Y.

## *SCIENTIFIC POSITIONS IN THE PHILIPPINE ISLANDS.*

THE Civil Service Commission announces that on June 1–2, 1904, examinations will be held for the positions named below in the Bureau of Government Laboratories at Manila, P. I.

| | |
|---|---|
| Pathologist | $1,800 |
| Pharmacologist | 1,800 |
| Chemist, Analytical Division, soils and waters | 1,600 |
| Chemist, Economic Products Division, familiar with organic chemistry, essential oils, etc | 1,600 |
| Chemist and collector, Economic Products Division | 1,500 |
| Assistant for physical chemist | 1,500 |
| Entomologist | 1,400 |
| Bacteriologist of Serum Division | 1,400 |

These salaries represent the lowest salaries for entrance into the Bureau and it is the plan, as far as possible in the future, to bring in new men in the lowest salaried positions,

giving them the opportunity for promotion as those in the higher positions leave or are promoted. In order to show what these higher salaried positions are, a list of the positions now authorized in the Bureau of Laboratories is given:

BIOLOGICAL LABORATORY.

| | |
|---|---|
| Director, Biological Laboratory | $3,500 |
| Pathologist and investigator | 2,750 |
| Pathologist | 2,250 |
| Pathologist | 2,000 |
| Bacteriologist | 1,800 |
| Entomologist | 1,800 |
| Bacteriologist | 1,500 |
| Assistant bacteriologist (two) | 1,200 |

CHEMICAL LABORATORY.

| | |
|---|---|
| Chemist and investigator | 2,500 |
| Chemist, Economic Products Division | 2,250 |
| Analyst | 2,000 |
| Botanist | 2,000 |
| Physiological chemist | 1,800 |
| Assayer | 1,800 |
| Chemist (two) | 1,600 |
| Analyst | 1,600 |
| Chemist | 1,500 |

SERUM LABORATORY.

| | |
|---|---|
| Director, Serum Laboratory | 3,000 |
| Assistant director | 2,500 |
| Veterinarian | 1,600 |
| Assistant | 1,400 |
| Assistant bacteriologist | 1,500 |

Vacancies are liable to occur in this list, and the employees who are at present in the bureau, if fit for the work, will, step by step, be promoted as the opportunity arises. Energetic young men who are willing to work up in the service are desired. Colleges and universities which are able to train properly qualified men are requested to submit lists of candidates each year so that a sufficient number of names may always be on hand. Facilities for all classes of work will be of the best, and an adequate library will be available.

## *THE CAMBRIDGE MEETING OF THE BRITISH ASSOCIATION.*

As we have already reported the British Association will meet this year at Cambridge, under the presidency of the Honorable A. J. Balfour, the British premier, from August 17 to 24. We take from *Nature* the following facts in regard to the meeting:

In 1833, the third year of its existence, the association met at Cambridge under the presidency of Professor Adam Sedgwick; Sir J. F. W. Herschel presided over the second meeting in 1845, and the third Cambridge meeting was held in 1862 under the presidency of Professor Willis.

The sectional meetings will in most cases be held in the buildings of the several science departments. The sections are the following: A, mathematical and physical science, president, Professor Horace Lamb, F.R.S.; B, chemistry, president, Professor Sydney Young, F.R.S.; C, geology, president, Mr. Aubrey Strahan, F.R.S.; D, zoology, president, Mr. William Bateson, F.R.S.; E, geography, president, Mr. Douglas W. Freshfield; F, economic science and statistics, president, Professor William Smart; G, engineering, president, Hon. Charles A. Parsons, F.R.S.; H, anthropology, president, Mr. Henry Balfour; I, physiology, president, Professor C. S. Sherrington, F.R.S.; K, botany, president, Mr. Francis Darwin, F.R.S.; L, educational science, president, the Right Rev. the Lord Bishop of Hereford.

A 'Handbook to the Natural History of Cambridgeshire' specially written for the meeting under the editorship of Dr. J. E. Marr and Mr. A. E. Shipley, will be published by the University Press; the syndics of the press have decided to present a copy to each ticket-holder, provided that the number to be supplied for the purpose does not exceed 2,000 copies. A special edition of Mr. J. W. Clark's 'Guide to the Town and University' will be presented to each member of the association, also a series of excursion guides, together with a colored map of East Anglia supplied by the director-general of the ordnance surveys.

Emmanuel College has agreed to entertain the secretaries of sections. The majority of the colleges have expressed their willingness to entertain free of charge a limited number of distinguished guests, and some of the colleges have agreed to place rooms at the disposal of members of the association, making a charge for meals and attendance. Girton and

Newnham Colleges, and the Ladies' Training College, have also agreed to extend hospitality and lodging accommodation to British and foreign visitors.

A considerable number of favorable replies have been received in answer to invitations issued to American and foreign men of science; it is expected that at least 100 visitors from abroad will be present.

The master and fellows of Trinity College have granted the use of the college for a conversazione and reception to be held on Thursday, August 18. The Lord-Lieutenant of Cambridgeshire and the Mayor of Cambridge will entertain the members and associates at a garden-party in the Botanic Garden on Monday, August 22. The High Sheriff of Cambridgeshire has also expressed his intention of giving a garden-party during the meeting. On Friday, August 19, a garden-party will be given by the principal of Girton College, and on Tuesday afternoon, August 23, members of the association will be entertained at Newnham College.

It is hoped that a *table d'hôte* lunch will be served on week-days in certain college halls. Light refreshments will be served each day (including Sunday) in the Masonic Hall, adjoining the museums and close to the reception room, from 12 to 8 P.M. It has also been arranged to have an open-air café and beer-garden on ground adjoining the museums, which will be open on week-days from 11 to 6.

The committee has provisionally arranged eleven excursions for Saturday, August 20. These include Audley End and Saffron Walden, Brandon and Didlington Hall (flint-knapping industry and Lord Amherst's collection of Egyptian antiquities), Cromer (geological), the Dykes of Cambridgeshire; Ely, Hatfield and St. Albans, Lincoln, Lynn, Castle Rising and Sandringham, Norwich, Wicken Fen, Wisbech and Woad Works.

On Thursday afternoon, August 18, the registrary of the university, Mr. J. Willis Clark, will deliver a lecture on 'The Origin and Growth of the University.' The evening lecture on Friday, August 19, will be on 'Ripple-marks and Sand-dunes,' by Professor George Darwin, and on Monday, August 22, the second evening lecture will be delivered by Professor H. F. Osborn, of New York, who will give an account of 'Recent Explorations and Researches on Extinct Mammalia.' On Saturday, August 20, Dr. J. E. Marr will lecture to the operative classes on 'The Forms of Mountains.'

A classified list of lodgings and hotel accommodation is now being prepared for the use of intending visitors. Information in regard to lodgings may be obtained from Mr. A. Hutchinson, Pembroke College. General inquiries should be addressed to the local secretaries, British Association, or to Mr. A. C. Seward, Emmanuel College, Cambridge.

## SCIENTIFIC NOTES AND NEWS.

Dr. John M. Clarke, paleontologist of the state of New York, has been appointed by the regents of the University of the state of New York to succeed Dr. Frederick J. H. Merrill as geologist and director of the State Museum.

Dr. F. S. Earle, assistant curator of the New York Botanical Garden, has resigned to accept the office of director of the new agricultural station in Cuba. The station will occupy a farm and buildings at Santiago de la Vegas, about twelve miles from Havana. The sum of $75,000 has been appropriated for the establishment and maintenance of the station for the first year.

Dr. Herbert Haviland Field, director of the Concilium Bibliographicum, has been elected an honorary member of the Leipzig Society of Naturalists.

Sir Guilford L. Molesworth has been elected president of the British Institution of Civil Engineers.

Professor V. L. Kellogg, head of the department of entomology of Stanford University, will spend the greater part of next year in Germany, Italy and England.

Dr. M. P. Ravenel and Dr. Leonard Pearson, of the University of Pennsylvania, are about to go to Italy to undertake researches on tuberculosis in the laboratory of Professor Maragliano, at Genoa.

Dr. R. Hoernes, professor of geology in the University of Graz, has been sent by the

Vienna Academy of Sciences to Macedonia to study the earthquake of April 4.

MR. PERCY LONGMUIR, of University College, Sheffield, has been appointed junior assistant in the metallurgical department of the British National Physical Laboratory.

As we have already noted, General Bassot has been appointed director of the observatory at Nice in the room of the late M. Perrotin. M. Simonin has been appointed sub-director of the observatory.

PROFESSOR H. C. PARKER, of Columbia University, lectured before the Geographical Society of Philadelphia on May 4, his subject being 'Mountaineering in the American Alps.' The Elisha Kent Kane medal of the society, awarded to Captain Robert F. Scott, R.N., commander of the *Antarctic* in its recent expedition to the polar regions, was accepted on his behalf by Wilfred Powell, Esq., British consul at Philadelphia.

PROFESSOR W. S. FRANKLIN, of Lehigh University, lectured before the Electric Club of Pittsburg on the 'Electron Theory' on May 2.

PROFESSOR FRANCIS E. LLOYD, of Teachers College, Columbia University, lectured before the American Philosophical Society, on May 6, on 'The Vegetation of the Island of Dominica.' Professor Lloyd spent the summer of 1903 in a botanical exploration of the island.

DR. J. A. EWING, director of naval education, formerly professor of mechanism and applied mechanics in the University of Cambridge, has been appointed Rede lecturer for the present year.

THE certificate of incorporation has been filed of the Walter Reed Memorial Association for the purpose of securing funds to erect a monument in Washington City to the memory of the late Walter Reed, major and surgeon U. S. Army. Dr. Daniel C. Gilman is president, and General George M. Sternberg, vice-president of the association.

THE trustees of the British National Portrait Gallery have received by bequest from the late Mr. Herbert Spencer a portrait of himself, painted by J. B. Burgess, R.A., and a marble bust of himself by Sir J. E. Boehm, R.A. The trustees have purchased a portrait of Sir Isaac Newton, painted as a young man and attributed to Robert Walker.

A COMMITTEE has been formed with the object of collecting subscriptions for the erection of a memorial to James Watt in Greenock, the place of his birth. The site of the house in which Watt was born is the property of the corporation of Greenock, and is placed at the disposal of the committee. The form of memorial will depend on the amount of money collected.

PROFESSOR MAXWELL SOMERVILLE, who occupied the chair of glyptology at the University of Pennsylvania and was a well-known authority on gems, has died at Paris, at the age of seventy-five years.

M. EMILE DUCLAUX, professor of physics and meteorology in the Agricultural Institute at Paris and member of the Academy of Sciences, has died at the age of sixty-four years.

WE regret also to record the death of Professor Moritz Staub, of Buda Pesth, secretary of the Hungarian Geological Society.

THE Civil Service Commission announces an examination on June 4, to secure eligibles to fill a vacancy in the position of chemist in the Bureau of Chemistry of the Department of Agriculture in connection with the inspection of foreign food products, at a salary of $2,000 per annum, and vacancies in the position of chemist of like character, in equal or lower grades, as they may occur in that department.

PRESIDENT ROOSEVELT has decided that the new buildings of the Department of Agriculture shall be built facing the park way that the park commission has recommended to extend through the Mall.

MR. CHARLES H. STERNBERG, of Lawrence, Kans., is prepared to send on approval collections of the reptiles and fishes of the chalk of Kansas.

A MASSACHUSETTS Zoological Society was incorporated last week with a view to establishing a Zoological Park in Boston. The park will be situated in the Stony Brook Reservation, and it is hoped that from $100,000 to

$200,000 will be collected and that work will be begun a year hence. The incorporators are Dr. Charles Sedgwick Minot, president; John E. Thayer and Dr. Henry P. Bowditch, vice-presidents; Dr. Edward G. Gardiner, secretary; Rev. James Eells, treasurer; Outram Bangs, Alexander Pope, William Lyman Underwood and the president and secretary, executive committee; Robert A. Boit, William F. Beal, Rev. Samuel A. Eliot, Hon. John D. Long, Robert M. Burnett, Samuel Hooper Hooper, Professor E. L. Mark, Dr. Samuel J. Mixter, Professor Edward S. Morse, Frederick Law Olmsted, Hon. Herbert Parker, John C. Phillips, Dr. Morton Prince and Professor William T. Sedgwick.

It is stated in *Nature* that a provisional program of the meeting of the International Association of Academies, to be held in London, has been sent to the delegates. On Tuesday, May 24, the commission inquiring into the anatomy of the brain will probably meet at Burlington House in the morning. In the evening the delegates will be entertained by the Royal Society at a banquet at the Whitehall Rooms. Wednesday, May 25, and the morning of the following day will be devoted to the business of the assembly. The king has expressed his wish, if his engagements will permit, to receive the delegates, and it is hoped that arrangements may be made for this event in the afternoon of May 26. On Friday evening, May 27, the delegates are invited to a reception by the University of London; and on the afternoon of May 28 it is proposed to pay visits to the universities of Oxford and Cambridge. On Monday, May 30, the Lord Mayor of London will entertain the delegates at a banquet at the Mansion House.

At Thurlow-park, Norwood, on March 17, Sir Hiram Maxim gave, as we learn from the London *Times,* a demonstration of his new 'Captive Flying Machine.' To a central vertical shaft, over 60 feet high, are attached ten long radial arms, supported by steel wire ropes, and from the ends of these arms are slung cars, each carrying six or eight passengers, and made in the shape of fish or any other form that fancy may dictate. Each is provided with an aeroplane, and by the varying of an angle, and consequently of the lifting power, of this they can, when the peripheral speed is high enough, be made to move up and down and perform complicated evolutions in the air. The speed was not great enough to bring the aeroplanes into action; exigencies of space made it necessary for the cars to be hung about forty feet from the ground, and the diameter of the circular path they followed was so small that sufficient speed to affect the aeroplanes would have been accompanied by an undue development of centrifugal force, owing to increased speed of rotation. The machine, however, is destined for Earl's-court Exhibition, where it will be erected in the middle of the lake; and there the cars will be hung much lower, and with a large circle of travel the peripheral speed will be high enough to bring the aeroplanes into play with a very moderate number of revolutions a minute. The central shaft is driven by a gas-engine, which can turn it at such a rate that the peripheral speed of the cars becomes about sixty-five miles an hour, and they are forced out at an angle of nearly 80 degrees to the vertical; but at Earl's-court the highest possible speed will be 35 miles an hour. A still larger machine is being built for the Crystal Palace, and as the space there is not limited the circle round which the cars travel will be so large that their speed will be high with only four revolutions a minute. In building these machines Sir Hiram Maxim's main object is, not to provide the frequenters of places of amusement with a new sensation, but to defray the cost of serious experiments in aeronautics. He feels certain that the time has now come when it is practicable to make a flying machine that can not fail to be of enormous value to the country as a military engine, and by the aid of the attractions of these captive flying machines at Earl's-court and the Crystal Palace he hopes to obtain from the public enough money to carry his experiments to a successful issue.

In order to promote uniform food standards and a uniform and just government control for the manufacture and sale of foods, there will be held at the St. Louis Exposition an International Pure Food Congress during the

week of September 26 to October 1, 1904. It is proposed to make this a congress of officials in charge of the enforcement of laws that control the purity of food products, of chemists conducting investigations of food products, of manufacturers and dealers in foods, and of all persons engaged in the preservation and distribution of food products. The topics for discussion will be: (1) Adulteration, misbranding and fraud in the sale of food and drink products. (2) The practical problems connected with the preservation, packing and distributing of the different food and drink products. (3) The use of antiseptics and coloring matters in foods and their effect upon the health. (4) Uniform standards for the quality and strength of dairy, food and drink products. (5) Uniform state, national and international laws to control the adulteration of foods, and fraud in the sale of foods, and the best methods for enforcing these laws. (6) Methods of analysis for the detection of food adulterants. (7) To expose such specific adulterations and frauds as may be brought to the attention of the congress, and to recommend methods for suppressing and controlling them. All inquiries concerning the congress should be addressed to R. M. Allen, Secretary, International Pure Food Congress, Lexington, Kentucky.

A South African correspondent writes as follows to the *Observatory:* "I have never come across any mention in an astronomical periodical of Carlyle's few remarks on astronomers, or of the fact that he was once a candidate for the directorship of the Edinburgh Observatory. It seems that this position was in the gift of Jeffrey of *Edinburgh Review* fame, and Jeffrey and Carlyle were intimate friends. Carlyle asked for the position, and was gruffly refused it by nearly the return post. Jeffrey appointed his secretary, whom Carlyle calls 'his taciturn friend with the blear eyes.' Who this was the writer knows not. Carlyle is good enough to say that Jeffrey's nominee did 'well enough.' Carlyle met Airy once—'a hardy little figure, of edacious energetic physiognomy, eyes hard, strong, not fine.' He met Legendre, whose Geometry he had translated in Edinburgh. He was also touched by the hem of Laplace's garment, thus:—"At a meeting of the *Institut* I saw and well remember the figure of Trismegistus Laplace; the skirt of his long blue-silk dressing gown (such his costume, unique in the place, his age and fame being also unique) even touched me as he passed on the session's rising. He was tall, thin, clean, serene, his face, perfectly smooth as a healthy man of fifty's, bespoke intelligence keen and ardent, rather than deep or great. In the eyes was a dreamy smile, with something of pathos in it, and perhaps something of contempt."

The following circular letter has been sent to English-speaking scholars by the rector of the University of Turin and the chief librarian of the National Library:

The commotion raised by the disaster of the National library of Turin, and the deep expressions of sorrow presented to it by the most eminent scientific bodies of every civil state, encourage us to address ourselves to the most illustrious of their members; whose studies are in accordance with the sections of the library that have been destroyed and of which sections it is our moral duty to endeavor the reconstruction in their most minute details.

Now since you are a worthy representative of this eminent scientific body and the studies you profess and cherish belong just to the sections destroyed, so we dare hope that in accordance with the joint solidarity which bounds together all the scholars of the world, you will favor and honor our library with the gift of your most esteemed books, which would be even more valued if adorned with an autographic dedication which would remind the studious of your generous present in a moment so painful for the studies.

This request that we have the honor to forward to you is entirely our personal and does not belong to the institution we represent, happy as we are of having an opportunity of so giving public homage to your high scientific attainments in conferring a benefit to the studies.

## UNIVERSITY AND EDUCATIONAL NEWS.

The corporation of the Massachusetts Institute of Technology has instructed its executive committee to confer with the Harvard University authorities on the subject of closer relations between the two institutions.

Wilson College, situated near Chambersburg, Pa., has received a bequest of $40,000 from the late John Lortz, to be used for the erection and maintenance of a natural science building.

Columbia University has received a gift of $60,000 from Mr. Horace W. Charpentier, A.B. ('48), for the chair of pediatrics.

Purdue University has dedicated an assembly hall, erected at a cost of $70,000, the gift of Mrs. Eliza Fowler.

The University of Leipzig has received from the estate of the late Herr Puschmann, 500,000 Marks for the study of the history of medicine.

A liquid-air plant will probably be installed in the basement of the Ryerson Physical Laboratory, of the University of Chicago, during the coming summer, at a cost of about $1,400.

The Chemical Laboratory of the Rensselaer Polytechnic Institute, at Troy, N. Y., was damaged by fire on the night of May 6. It is said that the fire was caused by an explosion of chemicals and that the loss amounts to nearly $75,000.

The British Chancellor of the Exchequer recently promised a deputation that the treasury grant to university colleges should be raised from £25,000 to £50,000 a year, and held out some hope that the sum might be raised to £100,000 next year. The following committee has been appointed to report on the allocation of the proposed increased grant: The Right Honorable R. B. Haldane, M.P. (chairman), Sir F. Mowatt, G.C.B., I.S.O., Mr. C. A. Cripps, K.C., M.P., the Rev. Dr. Woods, late president of Trinity College, Oxford; Mr. Henry Higgs, of the treasury, will act as secretary.

By a recent decree of Queen Wilhelmina the University of the Netherlands will recognize hereafter the degree of Bachelor of Arts from the following American institutions: The University of California, Catholic University of America, University of Chicago, Clark University, Columbia University, Cornell University, Harvard University, Johns Hopkins University, Leland Stanford Junior University, University of Michigan, University of Pennsylvania, Princeton University, University of Wisconsin and Yale University.

The trustees of Stanford University adopted on March 31 a form of organization which appears to differ from that of most universities by the creation of an advisory board. This consists of nine members, three being elected each year by the academic council or general faculty. All executive acts of general importance, including recommendations for appointments, promotions or dismissals, are to be submitted by the president to the advisory board for approval before they become operative or before they are submitted to the trustees for action, when such action is necessary.

A vacation course in geography, similar to that of August, 1902, will be held at the Oxford School of Geography during the first sixteen days of next August, provided that a sufficient number of students send in their names. It is proposed to have courses of lectures, probably on the British Isles and on the principles of geography applied to education, and in addition to have classes for practical work both in and out of doors.

Professor Albert W. Smith, of Stanford University, has been appointed director of Sibley College, Cornell University, succeeding the late Robert H. Thurston.

Miss Bertha May Clark, of Baltimore, holder of a foreign fellowship from the Woman's College of Baltimore, has been awarded the annual fellowship given by the Baltimore Association for the promotion of the University Education of Women. Miss Clark graduated from the Woman's College in 1900, was the holder of a graduate scholarship at Bryn Mawr College in 1900–1901, and was afterwards instructor in physics in the Woman's College of Baltimore.

Dr. Henry H. Dixon, who has been assistant to Professor Wright since 1892, succeeds him as professor of botany in Trinity College, Dublin.

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*Erratum:* The note on page 774 of the last issue of Science should read "Johns Hopkins gives opportunity for professional work in connection with the Geological Survey of Maryland."

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 20, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE RESOURCES OF MONTANA AND THEIR DEVELOPMENT.**

IN casting about for a theme for discussion at the opening of this the second meeting of the Montana Academy of Sciences, Arts and Letters, it seemed appropriate to follow some of the ideas suggested in my preceding address, and elaborate more fully the ideas advanced. This is all the more necessary since the work of the academy is yet in a formative period, and the members to a large extent have no means of communication save by mail. They have to a large extent not grasped the idea of the necessity of individual effort to do something definite in original work. This is not surprising from the fact that one easily loses enthusiasm and interest in the absence of kindred spirits with whom to talk matters over and thus keep alight the spark of interest.

The state of Montana, the state of grand mountains, whose snow-clad summits pierce the clouds, and whose hidden treasures are of untold richness; the state of blue sky, clear sunshine, pure air and crystal water; the state rich in mineral wealth, rich in timber resources, and with great possibilities for agriculture; the state with beautiful lakes, foaming rivers whose waters teem with the finny tribe, and with broad and fertile valleys rapidly filling with happy and prosperous people; the state in which are raised the finest and fleetest horses of the world; the state with its five millions

* Address delivered at the second annual meeting of the Montana Academy of Sciences, Arts and Letters, at Anaconda, Mont., December 29–31, 1903.

of sheep, its three quarters of a million of cattle, its one fifth of a million of horses; the state whose annual production of gold is five millions of dollars, of silver twenty millions, lead sixteen millions of pounds, copper a quarter of a billion of pounds, two million tons of coal, a half million dollars in stone, a half million dollars in brick and clay products; the state with its two millions of fruit trees, already producing a quarter of a million boxes of apples, its one and a quarter million tons of hay and nearly ten million bushels of grain; the state with its three thousand miles of railroads, its 42,000 square miles of forests, with a saw-mill product of nearly two millions of dollars annually; and yet the state is in its infancy. Its resources are barely known, and many are practically untouched.

The state has within its borders approximately ninety-four million acres of land. Of this amount twenty-six millions of acres are classed as mountain lands, thirty millions as farming lands, and thirty-eight millions as grazing lands. This is approximately 40,000 square miles of mountains, 50,000 square miles of farming lands and 56,000 square miles of grazing country. To put it in another way, the mountain area of the state is about equal to the entire area of either Indiana, Kentucky, Virginia, Ohio or Tennessee. Its grazing land is more than the total area of either Pennsylvania, Louisiana, Mississippi, New York or North Carolina. Its farming land is as much as in the entire state of Wisconsin, Iowa, Illinois, Michigan or Georgia.

We have a state with a mountain area of that of all Tennessee, a grazing area equal to all the area of Pennsylvania or New York, and farms left to cover the states of Illinois or Iowa. The mineral wealth of this state of mountains is as yet unknown, and new prospects open daily. The grazing possibilities are being greatly increased in the grazing section, and even much of the mountainous country has abundant and rich feed in summer. The agricultural region has yet to develop, but sufficient has already been done to predict a great future for the industry.

With a state equal in size to Indiana to supply gold, silver, copper and lead, as well as building stone and coal, another state equal in size to Pennsylvania to supply the beef, mutton, horses and goats for the mining population, and a state equal to that of Illinois to supply the grain, vegetables, fruits and hay, Montana is an empire in herself, capable of supplying all her wants. Clothing from wool, wealth from mines, grain and fruit from the fields and orchards, houses from the clay, rock or lumber, paper from the forests, coal from the hills, implements from the metals, gems from the mines, art in the peaceful valleys and rock-ribbed hills, fiction in Indian lore and trapper's tale of privation and suffering, poetry in nature, health in the air so pure and dry, sport in the hills or along the streams, all these make it possible for the citizens of this great empire to find at home, in their own state, all the essentials for modern civilized life, from the wants of nature to the esthetic realm.

Montana is a synonym for opportunity. This great state has less than two inhabitants per square mile. It presents to the man of health, energy and industry, an opportunity for successful business enterprise or professional advancement. Everywhere, on every side, there is opportunity. The great upheavals during the past geological ages have made mountain chains of great length and height, in whose depths man has already found untold wealth, and the hidden mineral yet unknown must be the heritage of the children of the future.

On the agricultural side what are the prospects for the future, based on the results of the experiments up to the present

time? The western part of the state is fast developing into a fruit region that will soon head off the great import of these products from Washington, Oregon and California. Of course the semi-tropical fruits will never be grown, but apples, pears, plums, small fruits and the like find here a climate suitable for growth. Nor is the region confined to the growth of fruits. Through irrigation great stretches of land grow waving grain, never failing the diligent farmer who but watches his fields.

On the eastern side the agricultural development has been beyond the most sanguine expectations. The valley of the Yellowstone has not only proved to be well adapted to fruit raising, but is now a great agricultural region. The climatic conditions are not as severe as were at first thought, and the outlook is as bright there as on the western side. The fame of the Gallatin valley is already widespread.

In the north is a large and unoccupied territory. Great stretches of tillable land await but the addition of water, which will make the country as rich and as prosperous as other sections of the state and country. The work of reclaiming the land is too great an undertaking for individual or corporate enterprise. But the beneficent effects of congressional legislation for the reclamation of arid lands through irrigation will soon be seen. In that northern section alone millions of inhabitants can find homes and occupations when the land is tilled. Abundant harvests will be gathered from the land, and cities will be found where now are trading posts and virgin soil.

During the past year it has been my pleasure to visit several parts of the state in connection with the work of the farmers' institutes. The gentlemen who have made up the companies of these institute instructors have given the closest attention to the possibilities of the regions of the state visited. Mr. W. B. Harlan, the veteran fruit grower of the Bitter Root valley, expresses the opinion that apples and small fruits can be grown successfully in the northern section of the state, although in the spring of 1903 there was not an orchard east of Chinook, and but one there. Professor F. B. Linfield, of the Agricultural College, believes that dry land farming, without irrigation, will in a few years be an important factor in the state's agricultural development. Professor Fisher, horticulturist in the Agricultural College at Bozeman, like Mr. Harlan, is also of the opinion that fruits may be grown where now it seems impossible to grow them.

What of the mines? The future for agriculture is no brighter than that for mining. 'New districts of magnitude and splendid values are constantly being developed,' says the State Commissioner of Agriculture. While the early history of the state is really the history of the development of some of its mines, mining now is not confined to a few sections of the state. In 1900 mining was carried on for gold and silver in the following counties: Beaverhead, Broadwater, Cascade, Chouteaou, Custer, Deer Lodge, Fergus, Flathead, Granite, Jefferson, Lewis and Clarke, Madison, Meagher, Missoula, Park, Ravalli and Silver-Bow. Lewis and Clarke was the greatest producer, with 70,000 fine ounces of gold and 172,531 fine ounces of silver. Custer County was the smallest producer, with 14.5 ounces of gold and 4 ounces of silver. The total product of gold and silver in the state in 1900 was 229,114.882 ounces of the former and 14,294,835.11 of the latter. In 1901 there were 232,331.454 ounces of gold and 14,180,545.19 ounces of silver. Since the discovery of gold in the state forty years ago more than one billion dollars in value of gold, silver, copper and lead have been

taken from the streams and mountains of the state. The industry is one of great importance to the state.

In 1901 copper was mined in the counties of Beaverhead, Granite, Jefferson, Lewis and Clarke, Madison, Meagher and Silver Bow, the last producing 227,742,262 pounds of the 228,031,503 pounds total. Lead was produced in all the counties mentioned except Madison, and in addition also in Broadwater, Cascade and Flathead. Broadwater and Meagher were about equal producers, with about two and one half million pounds each.

Coal statistics from an article by Professor J. Perry Rowe, of the University of Montana, which appeared recently in the *American Geologist,* show that Montana is undoubtedly one of the richest states in coal and lignite, although as yet these deposits have been but very little developed.

"All or most of the bituminous and semi-bituminous coals found in Montana come from the Cretaceous period and usually from the upper part, or the Laramie formation, and are found east of the main divide of the Rocky Mountains. The lignite is found both in the Cretaceous and later Neocene formations."

Professor Rowe says that it has been estimated that there are 13,000 or more square miles of Cretaceous bituminous and semi-bituminous coal area in Montana, and about 25,000 square miles of lignite area. "Not that all of this area is underlain by coal, but that the deposits are found quite abundantly throughout the territory." According to this estimate the coal area of the state is about one fourth of the entire area of the state. He says: "The bituminous area of Montana is greater than the combined bituminous areas of North Dakota, South Dakota, Wyoming, Washington, Oregon, Idaho and New Mexico. The lignite area is next to that of North Dakota, which has a larger lignite area than any of the northwest states." The tests show the Montana bituminous coal to be but little inferior to Pennsylvania bituminous coal. Professor Rowe reports that bituminous coal or lignite has been found in every county of the state except Jefferson County. The undeveloped coal industry will without doubt be a prominent factor in the expansion of other industries of the state.

*Sapphire Fields.*—Montana sapphires were first described in 1873 by J. Lawrence Smith, but actual mining began in 1891. One sapphire belt is twelve to eighteen miles east and northeast of Helena, and has been followed for about twelve miles, from Canyon Ferry down the river to American Bar. Sapphires have also been found at Rock Creek, Cottonwood Creek and Yogo Gulch. The Rock Creek region is about thirty miles west of Anaconda, the Cottonwood Creek field about ten miles east of Deer Lodge, and the Yogo mines in Fergus County, about thirteen miles west of Utica. The only systematic mining for sapphires in the United States is done in Montana. The annual output of sapphires in the state is something like 450,000 to 500,000 karats, including those suitable for cutting and those used for mechanical purposes. A lapidary at Helena has fifteen workmen cutting stones, and it is asserted that finer work is done here than on stones sent to be cut in London. "Altogether," says State Commissioner Ferguson, "the output of precious stones in Montana exceeds the production of all the rest of the United States, and forms a very interesting addition to our industries."

*The Lumber Industry.*—For the year ending June 30, 1902, 69 mills were running, with a total output of 210,047,000 feet of rough lumber. There were, in addition, from these mills, about five and a half million shingles and seventeen million

lath. The United States Geological Survey estimates the timber on the Lewis and Clarke forest reserve at 2,664,360,000 feet, board measure, and on all the reserves in the state 14,974,800,000 feet of merchantable lumber. It is estimated that there are 912,000,000 feet on state lands, bringing the total estimate of merchantable timber belonging to the state or government up to 15,886,800,000 feet. This does not include timber on the Northern Pacific Railroad land nor on the land belonging to the various mills. At the present rate of consumption the timber on the state and government lands would satisfy the mills for about seventy years. But the rate of consumption is increasing very rapidly.

An analysis of the industries which are lacking or very small shows the following: There are no zinc smelters in the state. The industry in iron and steel is not yet an integral part of the wealth of the state. Notwithstanding the timber and grain in the state there is not one pound of paper manufactured in the state. There are very few factories. The dairies are few and do not begin to supply the demand for butter. Montana produces 61 per cent. of the copper of the United States, but not a pound is converted into the finished product. Although Montana has more sheep than any other state in the union, it has but one woolen mill in the state.

If one wishes to make a study of the geology of the state or its natural history he has little to work on. Let the average student attempt to find out what is known relative to any section of the state, and he will have much difficulty. A portion of it has been covered by the work of the United States Geological Survey; much of it has not been studied. There is nothing obtainable save extracts from reports relative to the geology and natural history of the state. Teachers, students, private individuals alike must seek the libraries and cull from its numerous reports a small amount of information. Let me illustrate.

A student wishes to begin the study of the butterflies of the state and desires literature to aid him. What must he do? The eastern books cover the ground to the Great Plains. The insects from the Rocky Mountains are in great confusion. There is nothing to be placed in the hands of the student who wishes to work. He may secure Edwards's books with colored plates and full descriptions at $135. He may secure Holland's book with colored plates at $3. But without keys and full descriptions he can do little. Moreover, the material gathered from the state is very small, and collections are few. The student is beset at once with difficulties when he undertakes the work. His difficulties increase with continuance of study, and there is no help for him. The same is true of the study of fishes, birds, plants or mammals. There is nothing that the student who has not reached the plane where he can be called specialist may have for aid, unless he goes to the expense of books treating of the entire country. Even these will fail him often.

The study of the state's resources must be pursued with a twofold object in view: (1) To encourage immigration, (2) to enlighten the citizens of the state. We must all agree with Mr. Ferguson in his opening statement in his report as commissioner of agriculture, labor and industry for 1902, in which he says: "The magnitude and diversity of the natural history resources of this great state, the opportunities for the acquisition of comfortable homes and profitable investment are known to comparatively few people outside of its borders. It is clearly within the bounds of propriety for the people of any community to determine accurate knowledge of its advantages and invite immigration." We may as truthfully say that

it is clearly within the bounds of propriety for the people to determine for themselves what their natural advantages are, for their own enlightenment, for the education of the younger generation and for the development of the industries yet in infancy on a basis made from scientific study. I should make it more emphatic. It is not only within the bounds of propriety for the citizens of the state to do this, but it is their duty to promote the knowledge of their own material resources. We need people; there is no doubt of that. The state can easily support a population of several millions when its soil is under cultivation, when its orchards are bearing, when its new mines are opened up for full work and its other industries have developed. We need people, and we need them badly. We need capital also. This will come as soon as it is demonstrated that investment will be safe. But we are here, a quarter of a million of us. We are here, for the most part, to stay. The state's geological wealth and natural history wealth are the property of the people, and the people know little about it. It is not good business to be possessed of valuable property without making strenuous efforts to know something about the property.

Professor J. M. Hamilton said recently, in speaking to the students of the University of Montana, that the chief aim in our system of education should be to develop our resources and to know them, and that this will require the highest type of brain work. The resources are so varied that wide latitude may be had in the selection of work. The conditions are so varying that the greatest intelligence is necessary to carry on work which in other states requires little thought. The farmer must be an intelligent man and a student in order to handle water properly, so as to get the best results. The miner must be more than a laborer. He must know chemistry and physics. Every man must know more than is demanded of him by his daily work. He must have a big reserve.

The best men for developing the industries of the state will come from the youth of the state itself, if they are given the same facilities for carrying on their studies as are given their eastern competitors. These facilities are fast being supplied by the state institutions for higher education, which are now giving strong competition to the older and more widely known institutions. Add to this equipment the knowledge that may be had through daily contact with home conditions through the formative period of youth, and the young man will have the best equipment for his work that can be had.

The drift of my thought you have no doubt long since gathered. I am arguing for a geological and natural history survey by the state, for and by the people of the state and for outsiders if they wish to come into the state. We should have it. I believe we can have it, but we must work for it.

The history of the surveys of older states, and the reports printed, are ample proof of their utility. The value of a survey is beyond question. Granting that it should be established, the next step is to determine the breadth of the movement, the scope of the work, the policy to be pursued and the expense involved.

The survey should begin modestly, not attempting too much, developing plans slowly. Its board of directors should be entirely free from politics, and should include representatives from the various state institutions, and should include the governor of the state as chairman or president of the board. The bill recently drafted for the Wisconsin survey is a good model for use. All the institutions interested and all the scientific bodies should be made to feel that they are to have a

part in the work, for to get the best results will require the best effort of the best heads in the state. A governing board consisting of the governor, the president of the university, the president of the school of mines, the president of the agricultural college or the director of the experiment station, the president of the academy of sciences, arts and letters, with perhaps the president of the state board of horticulture and the president of the society of engineers, would certainly be above criticism, and would adopt a broad and liberal policy that would bring about excellent results.

The plan of operation should, of course, be left to the governing board, but the bill should specify the scope of the survey, which should include both the geology and the natural history of the state. This is the belief of those who have had much to do with the older surveys.

The expense should be modest for a beginning, and the work should be developed as necessities may warrant, or men of ability in special lines may be secured. A tax of one tenth mill for fish and game produces a revenue of from \$17,000 to \$18,000. A tax of equal amount for a state survey will give it a good start and make it possible to do most valuable work. An appropriation of not less than \$10,000, and possibly \$15,000, will enable the work to start at once with sufficient breadth to develop in several directions.

The work of the survey will take many years. Most of the work in the field will be in the summer. I doubt not men from the state institutions can be secured without big outlay for salary. This is at least to be expected. It will no doubt take years to carry out some of the outlines that will develop. Men living in the state who are in the employ of the state and who are fitted should be most valuable in many ways. Others not in state institutions will be found who will no doubt gladly assist, and there are many such who are competent. There is a long list of competent men to be found in the state, competent for some one line of work, at least. A few of these are already on the roll of the academy; more of them should be.

The above plan is, I believe, feasible. In one year the legislature meets. The state is in good financial condition. There is no reason why the survey should not be started. Some one must start it. The academy should foster the move. I advocated the move last year at our first meeting. I repeat it and urge action on the part of the academy. Speak of it through the press. Present it to those who have influence. If we all work zealously and earnestly it will surely go.

MORTON J. ELROD.
UNIVERSITY OF MONTANA,
MISSOULA, MONT.

## SCIENTIFIC BOOKS.

*The Harriman Alaska Expedition.* Vol. III., *Glaciers and Glaciation.* By GROVE KARL GILBERT, pp. i–xii, 1–231; 18 plates and 106 figures. Vol. IV., *Geology and Paleontology.* By B. K. EMERSON, CHARLES PALACHE, WILLIAM H. DALL, E. O. ULRICH and F. H. KNOWLTON, pp. i–x, 1–173; 33 plates and 18 figures. Published by Doubleday, Page and Company, New York, 1904. Size 7 by 10 inches.

Volumes one and two of the Harriman Alaska Expedition, containing a narrative of the journey and treating of the glaciers, natives, history, geography and resources of Alaska, were published in 1901. The two volumes recently issued are of special interest to geologists, and still others, as is understood, devoted to botany and zoology, are yet to come.

The Harriman Expedition, it will be remembered, was primarily a journey for pleasure and recreation, which twenty-three literary and scientific men were invited to accompany and it became a scientific reconnaissance embracing a wide range of subjects. The expedition

was conducted munificently and the series of sumptuous reports in process of publication under the editorship of Dr. C. Hart Merriam, are in keeping with the princely spirit manifest throughout the undertaking. The volumes that have appeared command attention and invite examination on account of their elegance and the good taste displayed by them. The artistic spirit which pervades them, although prominent, is subordinated to the faithful presentation of scientific results. The series of reports when completed will form a monument to the broad-mindedness of the originator of the expedition, such as no shaft of sculptured marble could furnish.

There is another point of view, however, from which the beauty and costliness of dress of the volumes in question may be considered. They are issued by a publishing house at $7.50 per volume, a price which puts them beyond the reach of many persons who would be glad to possess them. Although final reports so far as the Harriman Expedition is concerned, in reality they contain only the returns from a rapid reconnaissance. The distance from Puget Sound to Plover Bay, Siberia, and return, over eight thousand miles, was traversed by the expedition in fifty-eight days. As reports of such a voyage, during which much time was consumed in unprofitable travel, is it becoming to publish in so costly a manner? The thick paper, title pages in red and black, gilt tops, scores of plates, many of them in colors, tinted sketch-maps, vignettes, artistic chapter headings, etc., of these beautiful specimens of the bookmaker's art, like Easter bonnets and jeweled rings, are open to the criticism that the money they represent could have been better spent.

*Glaciers and Glaciation.*—Of all the branches of science represented by the men who accompanied the Harriman Expedition, the opportunities for study were certainly more favorable for the glacialist and the student of topographic forms than for any one else. At almost any locality from Puget Sound to the Aleutian Islands, where land is in sight, the student of glaciers and of the changes they make in the shapes of valleys, etc., can find material of special significance. In this connection Gilbert says:

> The glacier-bearing belt includes about three tenths of the vast territory of Alaska. Its exploration has but begun, yet enough is known to give it rank as the third great glacier district of the world, only the Antarctic continent and Greenland surpass it. Its ice may be roughly estimated to occupy a tenth of the surface, or an absolute area of between 15,000 and 20,000 square miles, and its expanse is so divided and scattered as to offer to the student the utmost variety of local conditions and detail. Of alpine glaciers, such as would receive individual names if near the homes of men, there are many hundreds, possibly more than a thousand; of broad, composite fields, like the Muir and Malaspina, there are about a half dozen; and more than thirty are known to reach the coast and cast bergs into the sea.

Of the vast mantle of snow and ice covering so much of Alaska, the members of the Harriman Expedition saw only a portion of the lower fringe. In southeastern Alaska and extending as far west as Yakutat Bay, the ground gone over by previous explorers was reviewed and many new facts obtained, and several modifications of previous conclusions arrived at. To the west of Yakutat Bay, and especially in the region of Prince William Sound, a fresh field for glacial studies was discovered and many important observations in reference to the distribution of glaciers, their fluctuations in length, etc., put on record. More than a dozen alpine glaciers of large size were discovered and several emptying into College Fiord were named in honor of American colleges and universities. The chief addition made to previous knowledge of the geography of the coast was the discovery of Harriman Fiord, a magnificent glaciated valley now in part occupied by the water of the sea, with many glaciers on its border, and a superb tidal glacier at its head.

The principal observations pertaining to existing glaciers presented by Gilbert may be conveniently grouped in five categories:

1. The distal ends of glaciers which terminate in the sea are shown to undergo fluctuations in length owing to seasonal changes in atmospheric conditions. These variations

are so pronounced that comparisons of the records of the position of the ice-wall of a tidal glacier made in different years need to be corrected for the time of year.

2. The influence on shore topography of the waves generated by bodies of ice which fall from tidal glaciers, or 'ice-fall waves,' is noted for the first time, and the possible influence of such waves on the shore features of partially ice-walled Pleistocene lakes suggested.

3. Anomalies in the fluctuations of neighboring alpine glaciers, as, for example, when one advances and another in an adjacent valley recedes, find many illustrations in Alaska. A discussion of the possible causes of such discordant changes when the conditions on which they are believed to depend are general and wide reaching is presented and is most suggestive.

4. The peculiar steep-sided depressions, many of them containing lakes, well known in certain formerly glaciated regions, are illustrated in the gravel deposits in front of several of the Alaskan glaciers which have recently retreated. The explanation of the origin of such depressions, first advanced, I believe by Professor W. O. Crosby, is that they are due to the melting of detached bodies of ice that were surrounded or covered by gravel deposits. The discovery of additional recent and typical examples of this nature by Gilbert gives greater confidence in the commonly accepted explanation.

5. A characteristic feature of the topography of formerly glaciated mountains is the occurrence, on the sides of the valleys once occupied by main or trunk glaciers, of tributary glaciated valleys which open into the main valleys high above their bottoms. Such tributary valleys have been termed 'hanging valleys.' The coast of British Columbia and southeastern and southern Alaska is exceptionally favorable for the study of the topographic features referred to; and in the volume under review several characteristic examples are described and admirable pictures of them presented.

The author favors the view that hanging valleys are due to the greater erosive power of a large trunk glacier over that of its shallower tributaries. That is, the discrepancy between the level of the bottom of a hanging valley and the bottom of the larger valley into which it opens is due to differential ice-erosion; the idea being that the surfaces of two glaciers which unite, are on the same level, while the bottoms of the valleys they occupy are deepened so as to be adjusted respectively to the thickness of the ice streams occupying them.

The explanation of the origin of hanging valleys by differential ice-erosion, while clearly and forcibly presented by the author, will, I think, fail to satisfy many persons who are familiar with the topography of formerly glaciated mountains. In view of the fact that Professor J. C. Branner reports hanging valleys on the Hawaiian Islands, where no suggestion of former glaciation can be claimed (*Am. Jour. Sci.,* Vol. XVI., 1903, p. 301), and that Gilbert in the volume under review with characteristic candor presents a sketch of a representative example in the mountain-wall of Plover Bay, Siberia, where concurrent evidence of glaciation is absent, suggest that at least two sets of conditions may have produced similar topographic forms. Again, in well glaciated mountains like the Cascades and Sierra Nevada, the great differences in level between a main valley and its tributary hanging-valleys, amounting in some observed instances to 1,500 or 2,000 feet, and this where the main valley is short and has but a comparatively small gathering ground for snow, must needs make the conservative glacialist pause before accepting the conclusion that such great discrepancies are due solely to differential ice-erosion. Other considerations in this connection might be mentioned, such as the fact that a deep glaciated valley with hanging valleys along its sides not infrequently heads against a cliff, and its direct continuation above the cliff also has the characteristic of a hanging valley. Then, too, hanging valleys may be claimed to occur on the sides of steep mountains, and on slopes overlooking the sea, where no evidence of a controlling ice body at a lower level is obtainable.

The above suggestions are presented and others might be added, for the purpose of indicating that the explanation of the origin of

hanging valleys, presented by Gilbert, although seemingly complete and unassailable, is perhaps not final.

In the volume under review the term 'tidal glacier' is substituted for the previously used and longer term 'tide-water glacier,' to designate ice streams which end in the sea. This substitution is welcome on account of its greater brevity, but I doubt if its meaning will be as readily grasped by the general reader as in the case of the longer term.

In the sections presented by Gilbert of the ends of tidal glaciers, the ice is represented as overhanging, and the only mode of formation of bergs that is recognized is from the breaking away of exposed portions of an ice cliff and their fall into the water at its base. The view is favored that the sea water causes a more rapid melting of the submerged portion of a glacier which advances into it, than occurs on the part of the ice above water. There can be no difference of opinion in this connection so far as the formation of most bergs from the glaciers of Alaska is concerned, but the 'blue bergs' which occasionally rise to the surface of the water at a distance of several hundred, and as estimates indicate, fully a thousand feet in some instances, in front of the visible ice-cliff of a tidal glacier, certainly indicate exceptional conditions. The birth of bergs from the extended submerged extremity of a glacier does not seem to have been observed during the Harriman Expedition.

In a chapter bearing the caption, 'General Considerations as to Glaciers,' four groups of features are discussed. (1) The broader characters of the surfaces of the lower portion of a glacier, or the 'glacier proper,' such as its evenness of surface as compared with the contours of the rock-floor on which it rests; lateral ice-cliffs due to heat reflected from the adjacent land and the influence of margining streams; and 'crevass cycle,' or the sequence of changes a series of crevasses, such as forms below an ice cascade, pass through. (2) Glacial sculpture, in the consideration of which the conspicuously different results produced by abrasion and 'plucking' are described and illustrated by photographs and sketches. (3) The pressure and erosive power of tidal glaciers, in the consideration of which an interesting theoretical discussion is indulged in in reference to the manner in which the distal end of a tidal glacier is supported. (4) The resemblances, differences, homologies and analogies of streams of water and glaciers, are clearly and most instructively indicated.

As I have attempted to show, Gilbert's sumptuous volume is most welcome to the special student of glaciers, both on account of the new facts it contains and of the new thoughts presented. It is clearly and concisely written, and must appeal to the general reader and entice him to make still more arduous journeys through the fields of glacial literature. One of its chief values is as a reading lesson for advanced students in college classes.

*Geology and Paleontology.*—Volume IV. of the Harriman Alaska Expedition bears internal evidence of being based on a reconnaissance much more clearly than its companion volume on glaciers and glaciation. Its table of contents reads: 'Introduction,' by G. K. Gilbert; 'General Geology,' by B. K. Emerson; 'The Alaska-Treadwell Mine,' 'Geology about Chichagof Cove,' and 'Minerals,' by Charles Palache; 'Mesozoic Invertebrate Fossils,' by William H. Dall; 'Fossils and Age of the Yakutat Formation,' by E. O. Ulrich and 'Fossil Plants from Kukak Bay,' by F. H. Knowlton.

A noteworthy result of the geological studies, as is stated by Gilbert in the introductory chapter, is the correlation on fossil evidence of slates and shales in three widely separated localities—Yakutat Bay, Prince William Sound and Kadiak Island—and the determination of their age as Jurassic. The correlation referred to of terranes in areas over 500 miles apart, as stated by Ulrich, 'is by means of a fossil species of definite character, *Terebellina palachei,* common to them all.' This fossil is the type of a new genus of burrowing worm, of which only the tubes it made, composed of cemented sand-grains, have been discovered. The assignment of a Liassic (Lower Jurassic) age is based mainly on four species of algæ belonging to two genera which

have been identified with European forms. One of the genera is reported only from the Lias and the other ranges from the Lias to the Trias and Tertiary. Besides these fucoids, the worm tubes referred to above and a new genus of lamellibranch are used in determining geological age; as stated in the text, the evidence furnished by the worm-burrows and the molluscan shell is purely inferential, but so far as it goes corroborates that of the fossil algæ as to a Liassic age. To one who is not an expert in paleontology, the arguments presented both as to correlating the widely separated terranes now referred to the Yakutat formation, and the assignment of that formation to a subdivision of the Jurassic, seem based on meager data. Among the results presented by the geologist is the evidence of Eocene strata on the Alaskan peninsula. The fossils collected at various localities form the basis for describing thirty-eight new species, twelve Jurassic and the remainder Tertiary. The Jurassic fossils include seven new genera. The descriptions of new species are accompanied by twenty-five admirable plates.

In the chapter on general geology, page 12, in describing the basaltic region about Shoshone Falls, Idaho, mention is made of 'great pustules which had been inflated on the surface of the liquid mass and then congealed and collapsed.' This explanation of the origin of the numerous 'pressure ridges' of the Snake River lava plains is so widely at variance with the conclusion reached by myself after gaining considerable familiarity with them, that it seems advisable to refer the reader to a more extended account of their characteristic, namely, U. S. Geological Survey, Bulletin No. 199, 1902, pp. 95–96.

The advantages presented by Alaska for glacial studies has already been referred to, and the reports of the geologists of the Harriman expedition, if we had no other evidence, suffice to show that the same land has an instructive geological history. Although the reports under review contain a few admirable pictures of volcanoes, only one, Bogoslof, seems to have been visited. As is well known, however, the volcanoes of Alaska present a subject for study fully as extensive and equally instructive as its glaciers, but one concerning which but little definite information is available. Another region of special interest which invites investigation and gives promise of valuable return is the vast tunda in the far north. Concerning one of these great groups of earth features, namely, the glaciers, the Harriman expedition has done good service not only in recorded results, but in indicating the richness of the field that remains to be explored. The others, as is well known, are fully as important and equally inviting. The suggestion I wish to convey by these statements is that there are room and material for study in Alaska for many more expeditions. The great and lasting results recorded in the reports of the Harriman expedition should encourage other broad-minded citizens to immortalize their names in a similar manner.

Israel C. Russell.

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## *SOCIETIES AND ACADEMIES.*

### THE MICHIGAN ACADEMY OF SCIENCE.

The tenth annual meeting of the Michigan Academy of Science was held at Ann Arbor, on March 31 and April 1 and 2. The new medical building, the university museum and the laboratories of botany and zoology of the University of Michigan were placed at the disposal of the academy for its sessions. The officers for this meeting were:

*President*—Professor F. C. Newcombe, Ann Arbor.

*Vice-Presidents*—Section of Agriculture, Professor W. J. Beal, Agricultural College; Section of Botany, Mr. B. O. Longyear, Agricultural College; Section of Geography and Geology, Professor I. C. Russell, Ann Arbor; Section of Sanitary Science, Professor C. E. Marshall, Agricultural College; Section of Zoology, Professor R. H. Pettit, Agricultural College.

*Treasurer*—Professor H. L. Clark, Olivet.

*Librarian*—Dr. G. P. Burns, Ann Arbor.

*Secretary*—Dr. Jas. B. Pollock, Ann Arbor.

The meeting opened Thursday, March 31, with a general business session at 2 p.m. Following the adjournment of this general session the various sections met for the reading of papers. Thursday evening no session

of the academy was held, as the members were invited to attend the dedication of the new science building at the State Normal College at Ypsilanti, Mich. Friday forenoon was devoted to the reading of papers in the various sections. In the afternoon the academy convened in general session and the retiring president, Professor F. C. Newcombe, of the University of Michigan, delivered the presidential address, taking as his subject 'The Manner and Means of a Natural History Survey of Michigan.' This address will be published in full in the annual report of the academy. The subject is one to which the academy is devoting much attention, and it is hoped that at the next session of the state legislature a law will be passed authorizing a natural history survey for Michigan, similar to those already established in other states. Following the presidential address the remainder of the Friday afternoon session was devoted to a discussion of the 'Forestry Interests of Michigan,' with the following program:

Charles W. Garfield, president State Forestry Commission, Grand Rapids: 'The State's Work in Forestry.'

John Bissel, Detroit: 'Forestry of Michigan from a Business Man's Standpoint.'

Filibert Roth, University of Michigan, Ann Arbor: 'The Next Step in Forestry in Michigan.'

J. W. Clark, of the U. S. Bureau of Forestry, Washington, D. C.: 'The Work of the Bureau of Forestry in Michigan.'

W. J. Beal, Agricultural College: 'Lantern Views of Seedlings and Young Forest Trees.'

E. E. Bogue, Agricultural College: 'Forestry Plantations in Michigan.'

C. A. Davis, University of Michigan, Ann Arbor: 'Condition of the Wood Lot in Michigan.'

On Friday evening Professor John M. Coulter, of the University of Chicago, delivered the annual address in Sarah Caswell Angell Hall. The subject was 'A Neglected Naturalist,' and under this title a most interesting account of the life and work of Rafinesque was given. Immediately following Professor Coulter's address the visiting members of the academy were the guests of the Research Club of the University of Michigan at an informal reception and smoker.

On Saturday morning a general session was devoted to a discussion of the 'Fish and Game Interests of Michigan.' The following papers were presented at this time:

F. N. Clark, Supt. of U. S. Fish Hatchery, Northville: 'Commercial Fish and Fisheries.'

Charles E. Brewster, Chief Deputy, Department of Game and Fish Warden, Sault Ste. Marie: 'The Commercial Fishes of the Great Lakes.'

F. B. Dickerson, of the Michigan Fish Commission, Detroit: 'The Benefit to the State of the Artificial Propagation of Game Fish.'

C. H. Chapman, State Game Warden: 'Game Animals.'

L. Whitney Watkins, of the Agriculture College Board, Manchester: 'Game Birds.' (By title.)

In the meetings of the various sections of the academy the following papers were read:

### SECTION OF BOTANY.

G. P. Burns, Ann Arbor: 'Ecological Survey of the Huron River Valley, IV., Dead Lake.'

Miss Lura Warner, Ann Arbor: 'Regeneration of Root Tips after Splitting.'

Miss Mary E. Hedden, Ann Arbor: 'Conditions Influencing Regeneration of the Hypocotyl in *Linum usitatissimum*.'

Miss Annabel W. Clark, Ann Arbor: 'Regeneration of the Epicotyl in Seedlings of *Vicia Faba* and *Pisum sativum*.'

Miss Julia A. Haynes, Ann Arbor: 'Angle of Deviation at which Stems Show the Strongest Response.'

W. N. Fuller, Ann Arbor: 'Statocyst Function of Starch Grains in the Root Tip.' (By title.)

A. W. Pierson, Ann Arbor: 'The Occurrence of *Basisporium Gallarum* Molliard in Michigan.'

C. A. Davis, Ann Arbor: 'The Rough Barked and Smooth Barked White Oaks.'

F. H. Loew, Agricultural College: 'Importance of Plant Variation and Its Bearing on the Evolution of Species.'

S. Alexander, Detroit: 'Some Interesting Michigan Plants, Possibly Some New Species.'

W. J. Beal, Agricultural College: 'A New Edition of the Michigan Flora.'

J. B. Dandeno, Agricultural College: 'The Relation of Mass Action and Physical Affinity to Toxicity of Solution.'

E. E. Bogue, Agricultural College: 'Educational Requirements for the Profession of Forestry.' (By title.)

W. J. BEAL, Agricultural College: 'Extension Work in Agriculture.'

SECTION OF ZOOLOGY.

RAYMOND PEARL and MISS MARY H. BURR, Ann Arbor: 'A Statistical Study of Conjugation in *Paramœcium*.'

MISS FRANCES J. DUNBAR, Ann Arbor: 'Methods Used in Cultivating Pure Strains of *Paramœcium*.'

MISS JEAN DAWSON, Ann Arbor: 'On the Occurrence of a Gill in *Planorbis*.'

BRYANT WALKER, Detroit: 'Variation in the Forms of *Succinea ovalis*.'

A. G. RUTHVEN, Ann Arbor: 'Notes on the Mollusks, Reptiles and Amphibians of Porcupine Mountains, Mich.'

J. PLAYFAIR MCMURRICH, Ann Arbor: 'A New Type of Cerianthid and Its Significance.' (By title.)

ELLIS MICHAEL, Ann Arbor: 'Fish Fauna of Michigan.'

H. L. CLARK, Olivet: 'A Michigan Biological Survey.'

J. E. DUERDEN, Ann Arbor: 'The Antiquity of the Zoanthid Actinians.'

H. L. CLARK, Olivet: 'Snake Notes,' illustrated with specimens.

H. L. CLARK, Olivet: 'The Variability of Snakes.'

C. F. CURTIS RILEY, Ann Arbor: 'Some Reactions of the Agrionidæ Larvæ.'

S. J. HOLMES, Ann Arbor: 'Some Observations on Phototaxis.'

J. E. DUERDEN, Ann Arbor: 'An Exhibit Showing Commensalism of Crab and Actinian.'

SECTION OF GEOGRAPHY AND GEOLOGY.

FRANK LEVERETT, Ann Arbor: 'Bed Rock Topography of the Southern Peninsula of Michigan.'

A. C. LANE, Lansing: 'The Theory of Copper Deposition.'

A. C. LANE, Lansing: 'The Development of the Igneous Magma.'

A. C. LANE, Lansing: 'Artesian Wells Along the North Shore of Lake Michigan.'

I. C. RUSSELL, Ann Arbor: 'The Glaciers of the Three Sister Peaks, Oregon,' illustrated.

FRANK LEVERETT, Ann Arbor: 'The Glacial Geology of the Ann Arbor Quadrangle.' (By title.)

ISAIAH BOWMAN, Ypsilanti: 'A Case of Steam Capture at Rawsonville, Michigan.'

H. W. BERGER: 'Gravel Deposits on Marl at the Shore of Bass Lake, Livingston County, Michigan.'

I. C. RUSSELL, Ann Arbor: 'Lava Flows of the Deschutes Valley, Oregon,' illustrated. (By title.)

M. S. W. JEFFERSON, Ypsilanti: 'The Valley of the Yuma River, Cuba,' illustrated.

M. S. W. JEFFERSON, Ypsilanti: 'Wind Effects.'

F. W. KELSEY, Ann Arbor: 'Vesuvius Before the Eruption of '79.'

SECTION OF SANITARY SCIENCE.

T. B. COOLEY: 'Report of the Pasteur Institute for the Year Ending April 1, 1904.'

MORTIMER WILLSON: 'Personal Hygiene for Life's Afternoon.'

GUY S. KIEFER: 'Some Problems in Sanitary Science.'

MISS CARRIE A. LYFORD: 'Domestic Science in Its Relation to Sanitary Science.'

MISS JENNETTE CARPENTER: 'The Object of Cookery in Schools.'

FLOYD W. ROBISON: 'Iron and Fiber in Their Relation to the Food of Man.'

V. C. VAUGHAN: 'The Result of Sixteen Years of Work in the Bacteriological Examination of Drinking Water.'

RALSTON WILLIAMS: 'Typhoid Germs in Sewage.'

T. F. MARSTON: 'What Pure Milk Production Means to the Producer.' (By title.)

IRA O. JOHNSON: 'The Significance and Production of Walker-Gordon Milk.'

CHARLES E. MARSHALL: 'Associative Action of Bacteria in the Souring of Milk.'

H. B. BAKER: 'A Problem in Terrestrial Physics—What Causes the Earth's Rotation.'

T. B. COOLEY: 'Gun Shot Wounds and Tetanus.'

D. J. LEVY: 'Filtration of Enzymes.'

FRED MUNSON and W. R. SPENCER: 'A Preliminary Report on the Presence of Toxin in Liver Cells.'

DONALD MCINTYRE: 'The Intercellular Toxin of B. pyocyaneus.'

M. W. CLIFT: 'The Chemical Tests for Morphine in the Presence of Putrefactive Substances.'

D. J. LEVY: 'An Actinomyces Isolated from Man.'

L. M. GELSTON: 'Filtration of Virus of Rabies Through Paper.'

WARD J. MCNEAL: 'An Improved Medium for Cultivating Trypanosoma Brucei.'

F. G. NOVY and W. J. MCNEAL: 'Cultivation of Trypanosoma Evansi.'

F. G. NOVY and W. J. MCNEAL: 'Filtration and Agglutination of Trypanosomes.'

H. R. TERREY: 'A New Phosphorescing Organism.'

At the final business meeting on Saturday morning the following officers were elected for the ensuing year:

*President*—Dr. A. C. Lane, State Geologist, Lansing.

*Vice-Presidents*—Section of Agriculture, Professor W. J. Beal, Agricultural College; Section of Botany, Professor J. B. Dandeno, Agricultural College; Section of Geography and Geology, Professor M. S. W. Jefferson, State Normal College; Section of Sanitary Science, Dr. T. B. Cooley, director of the Pasteur Institute, Ann Arbor; Section of Science Teaching, Professor W. H. Sherzer, State Normal College; Section of Zoology, Dr. Raymond Pearl, University of Michigan.

*Secretary and Treasurer*—Professor C. E. Marshall, Agricultural College.

*Librarian*—Dr. G. P. Burns, University of Michigan.

At this meeting the academy voted to commence the publication of a bulletin, in addition to the annual reports now being issued. The bulletin will appear three times during the year, and will be in charge of an editorial committee consisting of the president, the secretary and Professor H. L. Clark, of Olivet. The principal object of this bulletin will be to disseminate among the people of the state who are interested in science, and especially among the teachers of science in the secondary schools, more information regarding the work the Academy of Science is doing than they now get from the existing publication.

Raymond Pearl.

### THE IOWA ACADEMY OF SCIENCES.

The eighteenth annual meeting of the Iowa academy was held in the physical lecture room of the State University of Iowa, Iowa City, April 14 and 15. The following papers were presented:

Bruce Fink: President's address, 'Two Centuries of American Lichenology.'

Gilbert L. Houser: 'The Animal Cell in the Light of Recent Work.'

W. S. Hendrixson: 'The Action of Chloric Acid on Metals.'

Gershom H. Hill: 'The Importance of Vital Statistics in the Study of Social Science.'

T. E. Savage: 'A Buried Peat Bed and Associated Deposits in Dodge Township, Union County.'

L. H. Pammel: 'Some Notes on Iowa Flora.'

Nicholas Knight: 'Some Features in the Analysis of Dolomite Rock.'

Nicholas Knight: 'The Softening of Hard Water.'

L. H. Pammel, Edna King and R. E. Buchanan: 'Some Bacteriological Examinations of Iowa Waters.'

Launcelot W. Andrews: 'The Determination of Chlorides by Means of Silver Chromate.'

Arthur W. Martin: 'A Chemical Study of *Rhus glabra.*'

J. E. Guthrie: "The 'Furcula' in the Collembola."

R. I. Cratty: 'The Flora of Emmet County, Iowa.'

W. M. Barr: 'Action of Sodium Thiosulphate on Silver Salts.'

John J. Lambert: 'Regeneration in the Crayfish.'

C. F. Lorenz: 'Single Lantern Stereoscopic Projection in Color.'

G. E. Finch: 'Notes on the Position of *Nileus vigilans* in Strata at Elgin, Iowa.'

R. E. Buchanan: 'The Development of the Plum, *Prunus americana.*'

B. Shimek: 'Additions to the Iowa Flora.'

H. W. Norris: 'The so-called Dorsotrachealis Branch of the Seventh Cranial Nerve in *Amphiuma.*'

H. W. Norris: 'The Vagus and Anterior Spinal Nerves in *Amphiuma.*'

Katy A. Miller: "The Lichen Flora of 'The Ledges,' Boone County, Iowa.'

W. S. Hendrixson: 'A Method of Determining Chloric Acid.'

Harriet M. Clearman: 'A Geological Situation in the Lava Flow, with Reference to the Vegetation.'

John C. Frazee: 'Synthesis of Ethyl Alcohol from Acetylene.'

Edwin Morrison: 'Old Experiments with New Apparatus.'

H. A. Mueller: 'A Preliminary List of the Flowering Plants of Madison County.'

Charles R. Keyes: 'Remarkable Occurrence of Aurichalcite.'

Charles R. Keyes: 'Certain Basin Features of the High Plateau Region of Southwestern United States.'

Charles R. Keyes: 'Note on the Carboniferous Faunas of the Mississippi Valley in the Rocky Mountain Region.'

L. Begeman: 'A Convenient Voltaic Cell.'

F. Bonnet: 'A New Method of Determining Compressibility of Liquids and Solids.'

Officers for the ensuing year were elected as follows:

*President*—B. Shimek, Iowa City.

*First Vice-President*—L. H. Pammel, Ames.

*Second Vice-President*—M. F. Arey, Cedar Falls.

*Secretary*—T. E. Savage, Capitol Building, Des Moines.

*Treasurer*—H. W. Norris, Grinnell.

H. W. NORRIS,
*Secretary.*

### THE RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

THE following papers unreported in SCIENCE have been read at recent meetings of the club: At the December meeting Dr. A. B. Prescott gave an account of work upon the 'Organic Perhalides' done in his laboratory from 1895 to 1900. He had been attracted to this field (1) from the interest of the relations between perhalides and the double halides, (2) because of the molecular significance of supercompounds as such, (3) by reason of the remarkable rôle of iodine in the iodonium bases made known in 1894, (4) on account of the singular individuality of the periodides of the organic bases formed by nitrogen, and (5) in order to pursue the question, what sort of basal constitution is necessary to a perhalide. The systematic production of all perhalides of pyridine was entered upon, followed by those of the picolines, quinoline and the common vegetable bases, as has been published from this work up to 1901. In continuation the author desires to so extend the study as to find something of whatever value perhalide formation possesses as a distinguishing measure of chemical character, and whether or not confined to 'salt-forming bases.'

At the same meeting Dr. A. S. Warthin gave a summary of his most recent work on the hæmolymph glands as he had found them in man and other animals.

At the February meeting Professors Asaph Hall and F. C. Newcombe gave an account of their researches. After explaining various methods employed in detecting errors of division in circles, Professor Hall submitted a table showing the division errors of the Lick meridian circle constructed by the Repsolds, of that at Washington by Pistor and Martins, and of that at Ann Arbor, also by Pistor and Martins.

For the first two instruments the errors were obtained by keeping one circle fixed on the axis and continually shifting the other. For the Ann Arbor circle the errors were found by the methods of Bessel for the determination of special marks giving the following values for the ten degree divisions:

| Division. | Error. |
|---|---|
| ° | ″ |
| 0 | 0.00 |
| 10 | —0.36 |
| 20 | —0.58 |
| 30 | —0.54 |
| 40 | —0.67 |
| 50 | —0.66 |
| 60 | —0.64 |
| 70 | —0.10 |
| 80 | +0.21 |

Professor Newcombe stated that the roots of many species of plants are known to bend against the current of a stream of water in which they may be placed. This rheotropic response was shown to be really a response to one-sided pressure, since the roots showed similar curves when they were wholly shielded from the stream of water by covering them with tubes of very thin collodion. The thigmotropism must be called forth either by the large extent of surface stimulated by the water stream, or by long continued irritation of the same cells in the sensory region, conditions which will rarely if ever be fulfilled in nature. The conclusion was drawn that, contrary to the general belief, terrestrial roots are not responsive to one-sided pressure such as they meet in nature.

At the March meeting Professor Wenley spoke on the relation of Plato's writings to modern research, and Professor Cushny discussed 'The Secretion of Acid by the Kidney.' Professor Cushny assumed that the renal tubules are chiefly engaged in absorbing some of the constituents of the glomerular fluid. By the intravenous injection of most neutral salts the urine was found neutral or feebly acid to phenolphthalein, while it was neutral or alkaline to litmus. The intravenous injection of phosphate rendered the urine acid to

phenolphthalein, while it was feebly acid or neutral to litmus; obstruction of one ureter now rendered the urine of that side more strongly acid. This was interpreted as indicating that the normal acidity of the urine is due to the absorption of sodium and hydroxyl or carbonate ions in the renal tubules. For the secretion of acid urine two conditions must be fulfilled: (1) There must be present in the blood and glomerular fluid a hydrolytically dissociated salt whose anion can not permeate the epithelium of the tubules, while the cation can permeate readily; (2) there must be an active absorption in the tubules.

Frederick C. Newcombe,
*Secretary.*

### THE AMERICAN MATHEMATICAL SOCIETY.

During the month of April the American Mathematical Society held three meetings. The Chicago Section met at Northwestern University on April 2, the San Francisco Section at Stanford University on April 30, and a regular meeting of the society was held at Columbia University, also on April 30. Reports of the sectional meetings will appear later in Science.

About fifty members attended the regular meeting in New York. The president of the society, Professor Thomas S. Fiske, occupied the chair. The following persons were elected to membership: J. J. Browne, Colorado School of Mines; C. E. Dimick, University of Pennsylvania; Wm. Gillespie, Princeton University; Clifford Gray, Columbia University; Louis Ingold, University of Missouri; Myrtle Knepper, State Normal School, Cape Girardeau, Mo.; F. M. Morrison, Buchtel College; G. W. Myers, University of Chicago; Elijah Swift, Harvard University. Eight applications for admission to membership were received.

During the past year two important reports have been prepared by committees of the society and published in the *Bulletin*. The report of the committee on college entrance requirements has been adopted by the College Entrance Examination Board as the basis of its examinations in mathematics on and after June, 1905. The second report, prepared by a committee of the Chicago Section, presents a unified scheme of requirements for the master's degree for candidates offering mathematics as the major subject. The society has also exerted, through its committee on relations to elementary mathematics, a guiding influence in the formation of associations of teachers of mathematics throughout the country. Several of these associations have already been organized under very favorable prospects, and others are already planned.

The following papers were read at the April meeting:

H. F. Stecker: 'Certain differential equations in relation to non-euclidean geometry.'

C. J. Keyser: 'Certain line and plane quintic configurations in point 4-space, and their sphere analogues in ordinary space.'

E. V. Huntington: 'A set of independent postulates for the algebra of logic (third paper).'

O. D. Kellogg: 'Sets of functions with preassigned singular points and monodromic group.'

J. M. Peirce: 'On certain complete systems of quaternion expressions and on the removal of metric limitations from the calculus of quaternions.'

E. O. Lovett: 'Singular trajectories in the problem of four bodies.'

E. O. Lovett: 'Systems of periplegmatic orbits.'

M. Bôcher: 'The Gauss-Stieltjes equilibrium problem and the roots of polynomials.'

J. Pierpont: 'On multiple integrals.'

E. L. Dodd: 'Multiple sequences.'

V. Snyder: 'On developable and tubular surfaces having spherical lines of curvature.'

C. H. Sisam: 'On self-dual scrolls.'

E. Kasner: 'The general transformation theory of differential elements.'

E. J. Wilczynski: 'General theory of curves on ruled surfaces.'

H. Taber: 'On real hypercomplex number systems.'

For the evening the usual dinner was arranged; twenty-five members attended this agreeable diversion.

The summer meeting of the society will be held at St. Louis on September 16–17. The San Francisco Section will also meet in September. The next meeting of the Chicago Section will be held at the Christmas holidays.

F. N. Cole,
*Secretary.*

THE TORREY BOTANICAL CLUB.

The meeting of February 24 was held at the New York Botanical Garden, Professor Underwood in the chair; sixteen persons present.

Dr. Britton referred to the opportunity of members to become applicants for a grant of fifty dollars from the John Strong Newberry Fund, which this year is available for botanical or zoological research.

The announced paper of the scientific program was by Mr. Percy Wilson under the title of 'Remarks on some Economic Plants of the East Indies.'

In the spring of 1901 Mr. Wilson was commissioned by the New York Botanical Garden to accompany the solar eclipse expedition to the East Indies organized by Professor Todd, of Amherst College, the chief purpose of Mr. Wilson's visit being to obtain collections of native plants and plant products for exhibition in the museum of the garden. Most of his collections were made on the island of Singkep, which is a two days' voyage southward from Singapore. This island is about twenty-five miles in length and sixteen in greatest width. Two thirds of it is covered with a dense tropical jungle, the remainder having small, scattered native villages. Various fiber products, starches and sugars, manufactured and used by the inhabitants of these villages, were shown. In discussing fiber products, examples were first exhibited in which a whole leaf or a considerable part of it is made use of. Of these leaf fibers, one of the most extensively utilized is from the leaves of the screw pines, whose generic name, *Pandanus*, is a Latinized form of the Malay word 'pandan,' a name applied to many species of the genus. In many of the East Indian islands, large tracts are covered by these *Pandanus* trees or shrubs, growing in such profusion as to form impenetrable masses of vegetation, while species growing singly or a few together abound principally in the vicinity of the sea. The latter bear many thick aerial roots, which at a distance have the appearance of supporting the plant in the air. The leaves and roots are the parts of chief economic importance. The leaves are gathered in large numbers, tied into bundles, and carried by the men to the villages, where the women remove with a large knife all spines from the margins of the leaf and the under surface of the midrib. The leaves are then exposed to fire, after which they are cut singly with a sharp four-bladed knife into strips of uniform width. After several days of soaking in water and bleaching in the sun, each strip is separately drawn between the thumb and a thin bamboo stick. By this treatment they become flexible and can be wrought into any desirable shape without injury to the fiber. Two plants in particular, 'pandan tikar' (*Pandanus Samak*), the mat screw-pine, and 'pandan laut' (*Pandanus fascicularis*), the seashore screw-pine, are considered as yielding the best grade of leaves for mat- and basket-weaving. Other species bearing larger and coarser leaves are regarded as inferior. Of these, the 'mengkuang' (*P. atrocarpus*), an arboreal form, is commonly found in swampy places. The leaves of this are made into hats, and into large mats which often serve for the entire sides of houses or for the covering of carts. Styles and designs in weaving differ in the different islands. In some places highly colored mats with red, green, brown and purple strips interwoven are to be found. The dyes used are said to be chiefly of vegetable origin. A red dye is extracted from the leaves of the teak, a green from the shoots of the banana, while brown or chocolate color is obtained by burying the strips in mud and water for several weeks. In some regions where species of *Pandanus* abound, these thick aerial roots are used for corks; sections of these roots several inches in length are beaten out at one end and thus made to serve as brushes. Leaf fibers from the leaflets of the 'nipah' (*Nipa fruticans*), a low, stemless palm, are woven into large shingles known as 'attaps.'

Fibers derived from the vascular bundles alone are obtained from the leaf-stalks of a common fern, *Dicranopteris linearis*. After the long bundles are split out from the stalks they are drawn separately through a series of holes of gradually diminishing sizes punctured in a piece of tin. With the strong fiber thus

obtained fine hats are made which are worn by the Malay men at their various festivals. The stems of the bamboo or strips and fibers obtained from them are put to a great variety of uses by the natives of the region.

Various food products of vegetable origin were then discussed. An important starch is sago, under which name are understood starches derived from several kinds of palms and cycads. Most of it, probably, comes from the trunk of *Metroxylon Sagu,* the true sago palm, which inhabits many of the islands of the Malay Archipelago. This palm grows to a height of forty feet or more and has a large, comparatively smooth trunk, from the interior of which the starch is derived. In the preparation of the sago a full-grown tree is selected just before the expansion of the inflorescence, the trunk is felled and cut into sections three or four feet in length, which are thrown into water and soaked for several days. Afterward, the outer fibrous portion is removed and the interior is reduced to a coarse sawdust by means of a crude grating apparatus. This sawdust-like powder is then put into a large vessel, where the starch is crushed out with the aid of water and the feet of a native. It is then drawn off, suspended in the water, and is finally dried and shipped away for refinement.

Palm sugar is derived chiefly from the sugar palm (*Arenga saccharifera*) and the cocoanut palm (*Cocos nucifera*). The sugar is obtained from the *Arenga* by binding the numerous branches of the pendulous inflorescence into a compact cylinder, without removing them from the tree, and then chopping off the ends and making several incisions along the sides of the branches. The sweet sap is caught in a vessel made from a bamboo-stem; it continues to flow for several days, is collected every twenty-four hours and is boiled down over a crude oven.

The paper was brought to a close with remarks on masticatories such as the betel-nut—the fruit of the Areca palm (*Areca Catechu*)—and on some of the edible fruits, such as the durian and mangosteen.

Mr. G. V. Nash showed flowering species of Melastomaceæ from the conservatories of the New York Botanical Garden, including one of *Heterocentron elegans* from Mexico and one of *Medinilla magnifica* from the Philippines.

Dr. N. L. Britton exhibited specimens of two apparently undescribed species of poplar from Wyoming, one allied to *Populus tremuloides,* the other to *P. augustifolia.*

Marshall A. Howe,
*Secretary pro tem.*

THE GEOLOGICAL SOCIETY OF WASHINGTON.

The 155th meeting was held on April 13 and Mr. J. S. Diller read a paper on 'The Composition and Structure of the Klamath Mountains.'

The lithologic, stratigraphic and faunal relations of the various sedimentary formations are considered in their order of development, beginning with the mica-schist, which is possibly of pre-Cambrian age. The Cambrian rocks of southeastern California and the Silurian rocks of the northern part of the Sierra Nevada have not yet been recognized in the Klamath Mountains, the oldest fossiliferous beds of that region being of Middle Devonian age. The stratigraphic succession of the Paleozoic and Mesozoic formations was discussed, and especial attention was devoted to the great unconformity which has been recognized at the base of the Cretaceous. The distribution of the marine and fresh-water Eocene in Oregon and the Miocene in California was indicated, as well as their relation to the development of the Trinity Basin.

In the next paper Mr. G. B. Richardson discussed 'The Stratigraphic Sequence in Trans-Pecos Texas North of the Texas and Pacific Railway.'

The rocks in this area range from pre-Cambrian to recent in age, most of the systems being represented. There are two areas of pre-Cambrian sediments: One is south of the Diablo Mountains between Eagle Flat and Vanhorn, where a group of folded and faulted formations consisting of silicious limestone, conglomerate, fine-textured red sandstone and schists is exposed. The other pre-Cambrian area is on the eastern flank of the Franklin Mountains, where there are about 3,000 feet of quartzite, slate and rhyolite.

The Cambrian is represented by 300 feet of sandstone of Acadian or Saratogan age exposed on the southeastern flank of the Franklin Mountains. Two other areas of sandstone of possible Cambrian age, but in which no fossils were found, are in the southern Hueco Mountains and northwest of Vanhorn.

The Ordovician is represented by about 1,200 feet of limestone in the Franklin Mountains. Three well-defined horizons are present, the Calciferous, the Galena Trenton and the Richmond. The Calciferous is also present in the southern Hueco Mountains and northwest of Vanhorn. A few isolated areas of limestone of the Niagara division of the Silurian occur in the Franklin Mountains.

The Devonian system and the Mississippian series of the Carboniferous are absent. The Pennsylvanian is represented by two limestone formations. The older occurs on the northwestern flank of the Franklin Mountains and the younger covers a large area in the Hueco, Diablo, Finlay and Cornudas mountains. These formations are each several thousand feet thick. In the Diablo Mountain region there is evidence that the pre-Pennsylvanian land was reduced to a peneplain.

Over 4,000 feet of rocks of Permian age containing a unique fauna which is being studied by Dr. G. H. Girty are present in the Delaware and Guadalupe Mountains. At the base of the section are 200 feet of black limestone. Above are over 2,000 feet of sandstone and interbedded limestone which are capped by 1,800 feet of massive white magnesian limestone. The relation of the Permian to the Pennsylvanian is concealed by the intervening Salt Basin.

A broad belt of gypsum, at least 300 feet thick, overlies these rocks and the gypsum is overlain by about 200 feet of sandstone and limestone which outcrop in a low range of hills west of the Pecos River. The age of these rocks is not known. They are either Permian or early Mesozoic.

The Jurassic is represented by a small limestone outlier of the Malone Mountains. The relations of these rocks to adjacent formations, however, is unknown, being concealed by unconsolidated basin deposits.

The Cretaceous is represented by the Fredericksburg and Washita divisions of the Comanche, which cover a considerable area. The Fredericksburg has been divided into three formations consisting of sandstone and limestone aggregating about 1,500 feet in thickness which are well exposed in the Finlay Mountains, about Sierra Blanca and in the southern Diablo Plateau. The Washita has not been subdivided. It consists of about 200 feet of buff-colored limestone and calcareous sandstone and shale well exposed near San Martine and Kent, and is present also in small outlying areas in the Sierra Blanca, Black and the Cornudas Mountains and in the vicinity of El Paso. There is evidence of the northward progress of the Comanche Sea in this area, shown by Washita rocks lying on the Carboniferous in the northern part of the area, while farther south rocks of Fredericksburg age immediately overlie the Carboniferous.

The Hueco, Salt and Toyah Basins—desert wash-covered areas characteristic of the Trans-Pecos country—are capped by unconsolidated detritus of Pleistocene age. Deep wells show that this material extends to considerable depths, and though no fossils have been found, possibly the lower deposits are of Tertiary age.

Mr. A. C. Veatch then discussed 'Some Peculiar Artesian Conditions on Long Island, N. Y.'

On Long Island, while the principles which govern artesian flows are necessarily those which produce the same phenomena elsewhere, there are certain essential modifications in the nature of the factors which produce these results. They may be briefly summarized as follows:

1. The deep zone of flow and the surface zone are essentially continuous. The whole island is composed of sands, with discontinuous clay masses, and the rain water is free to penetrate to any part of these beds without regard to dip.

2. The head depends not on dip of the strata, but on the curved nature of the ground water table, which gives to the water under a clay bed a pressure equal to the height of the

ground water above the edge of that clay mass, less the loss in transmission.

3. The dip of the strata is, therefore, immaterial, and flows, in many cases, are produced against or up the dip.

4. The slope of this ground water table is so precipitous at the heads of many of the deep reentrant bays on the north shore that a slight difference in porosity is sufficient to determine an artesian horizon, and wells in such situations and which penetrate nothing but sand and gravel are frequently artesian.

Alfred H. Brooks,
*Secretary.*

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The five hundred and eighty-fifth meeting was held April 22 and 23 jointly with the American Physical Society. Reports of the papers read during the day sessions will appear in the proceedings of that society.

On Friday evening Mr. Alexander Graham Bell delivered a lecture on 'Tetrahedral Kites,' exhibiting numerous small kites and the cells out of which large structures are built up, and many lantern views of the large kites he has flown at his experiment station in Nova Scotia. The noteworthy features developed by the experiments were the great strength combined with lightness of the kites for a given lifting power; their ability to rise more nearly vertically above the point of attachment at the ground than other forms of kites; and their remarkable steadiness, especially when the broadside is toward the wind. The speaker intends to carry on his experiments during the coming summer.

Charles K. Wead,
*Secretary.*

THE ASSOCIATION OF OHIO TEACHERS OF MATHEMATICS AND SCIENCE.

The association was organized at a meeting held in Columbus, April 2, 1904. At this meeting the following papers were read and discussed:

Pres. Charles S. Howe, The Case School of Applied Science, Cleveland: 'The Effect of Entrance Examinations upon the Mathematical Work of the Preparatory School and the College.'

Dr. George Bruce Halsted, Kenyon College, Gambier: 'The Value of Non-Euclidean Geometry to the Teacher.'

Professor Franklin I. Jones, University School, Cleveland: 'The Laboratory Method in High School Mathematics.'

In his paper Dr. Halsted pointed out that the results of the recent studies on the foundations of geometry now permit a simple and rigorous treatment of elementary geometry without the introduction of either continuity or limits. The constructions of elementary geometry are possible without the compasses by means of the rules alone.

THE NORTHEASTERN SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The fifty-second meeting of the section was held Friday evening, April 22, at Huntington Hall, Massachusetts Institute of Technology, Boston, with President W. H. Walker in the chair. About 650 members and friends were present. Professor W. P. Bradley, of Wesleyan University, gave an address on 'Efficiency Tests of the Wesleyan Liquid Air Plant and Demonstration of Liquid Air,' in which he described, and illustrated with lantern slides, the plant at Wesleyan University for the manufacture of liquid air, while the latter part of the lecture was devoted to a description of the properties of liquid air, which were demonstrated by numerous experiments.

Arthur M. Comey,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

ELLIPTICAL HUMAN ERYTHROCYTES.

I was much interested in a note by Professor Melvin Dresbach, of the Ohio State University, published in Science, March 18, 1904, giving an account of examinations of human blood, in which about ninety per cent. of the red corpuscles were oval. What rendered this observation remarkable—and indeed unique—was the statement that:

> The student in whose blood these corpuscles were found was a healthy mulatto about twenty-two years of age. His brother, who attended the university a few years ago, had normal red blood cells. Other than this no family history is at hand.

I wrote to Professor Dresbach a few days after reading this account, and he most kindly sent me a slide, dated January 10, 1903, for examination. Professor Dresbach wrote:

> The young man who furnished these peculiar cells was taken ill and left the city, and consequently I never saw him again. I have since learned that he died * * *.

It is unfortunate that there is no account of the disease that proved fatal in this case; and it is to be hoped that this defect in the history may be supplied later. It is well known that erythrocytes are often deformed—and sometimes many of them are oval—in certain blood diseases. To cite authorities that can be readily consulted, Osler writes, in treating of 'Progressive Pernicious Anemia':

> Microscopically the red blood-corpuscles present a great variation in size, and there can be seen large giant forms, megalocytes, which are often ovoid in form, measuring eight, eleven or even fifteen micromillimeters in diameter—a circumstance which Henry regards as indicating a reversion to a lower type. Laache thinks these pathognomonic, and they certainly form a constant feature. ('The Principles and Practice of Medicine,' New York, 1895, p. 729.)

These changes in the form of the corpuscles have been described under the name of poikilocytosis, and are referred to by Flint ('Principles and Practice of Medicine,' Philadelphia, 1886, pp. 60 and 386), in connection with pernicious anemia. Ewing ('Pathology of the Blood,' Philadelphia, 1903, p. 256) writes:

> Sometimes in non-infectious purpura hemorrhagica the red corpuscles are undersized and many are oval.

In view of these facts, it seems impossible to accept the proposition that the subject of the observation noted 'was a healthy mulatto.' He certainly was affected with poikilocytosis. As the oval corpuscles in this case measured 10.3 by 4.1 microns—certainly not enlarged, the normal corpuscles being seven to eight microns in diameter—it is possible that the poikilocytosis was a condition antecedent to a severe purpura hemorrhagica, which was the immediate cause of death. In pernicious anemia, the number of corpuscles is diminished and may become as low as 500,000 per cubic millimeter, instead of 5,000,000, which is the normal average, and megalocytes are nearly always found. Still, as there are no observations—with which I am acquainted, at least—in regard to the blood in pernicious anemia, before grave and distinctive symptoms have appeared, death may have been due to this disease.

Austin Flint.

Cornell University Medical College,
New York, April 25, 1904.

## CONVOCATION WEEK.

The Editor of Science writes: "Among the points on which an expression of opinion would be useful are: (1) Should the American Association maintain its sections for special papers or should these be left to the special societies? (2) Should the association attempt to popularize science, and if so how? (3) Should the association include in its scope education, economics, philology, etc.? (4) Should the association meet in summer or winter or both? (5) Should the association meet in regional sections, with only occasional joint meetings? (6) What should the association do to promote cooperation among men of science and the advancement and diffusion of science?"

After reading the great number of diverse opinions that have appeared in Science concerning the condition of the American Association and the nature of its work, every subscriber must begin to think something is wrong somewhere, though he may be utterly at a loss to know what remedies to prescribe.

The writer can not help thinking that most that has lately been written on the subject has added to the apparent unrest, on the whole very likely doing more harm than good. Each writer has committed himself to a certain policy, which he thinks should be adopted. With all this talk, it is not difficult to show that large additions of members have been made during the period of special or affiliated societies. Several of these societies have been the means of increasing the membership of the American Association instead of decreasing it.

1. Let the association keep up all its sections, possibly adding to the number, freely cooperating with special societies, each section showing a willingness to unite in preparing a program with any one or more special societies having a like object.

2. Years ago at meetings of the association, the late W. A. Rogers in Boston and E. S. Morse in Detroit, strenuously advocated the presentation of no papers that did not present the results of original work. Professor Cope often took the same ground, not infrequently helping to reject papers because of their popular nature.

I have recently thought it desirable to have a number of speakers selected by officers of the sections, perhaps with the approval of the council, to present some topic or series of topics in a popular way to attract 'outsiders.' It would hardly be safe to permit any volunteers to present papers on a popular topic.

3. Education, economics, but not philology.

4. Once a year, preferably in winter, till this date has had a fair trial.

5. Meet most of the time in populous regions from Washington to Boston, Detroit, Chicago, where many people are most sure to attend.

6. The association through Science is now performing a great work. W. J. Beal.

### ERRORS IN NOMENCLATURE.

To the Editor of Science: In the *American Naturalist* for February is a paper by Miss E. G. Mitchell purporting to date from Cornell University and expressing acknowledgments to Instructor H. D. Reed and myself. Besides some typographic errors it contains so many incorrect generic and specific names that, in justice to the university and ourselves, Dr. Reed and I feel obliged to disclaim responsibility for them. Two years ago some dissections and observations were made by Miss Mitchell in this laboratory, and she was probably encouraged to complete and publish them. But at that time our concern was with the subject-matter, and we did not undertake to verify the names of the fishes examined. Neither the manuscript nor a proof has been submitted to us recently, as would have been required before assenting to publication as if from the department. Others, like ourselves, probably query why the paper was not passed upon by the ichthyological editor of the *Naturalist*. A list of corrections has been sent to Miss Mitchell, in Louisiana, with the expectation that she will request their immediate publication. Burt G. Wilder.

Ithaca, N. Y.
May 2, 1904.

## *SPECIAL ARTICLES.*

### A REFERENCE TO THE ORIGIN OF SPECIES IN AN EARLY LETTER (1796) SIGNED BY BOTH LAMARCK AND GEOFFROY.

Among the papers of the elder Peale which were recently dispersed in Philadelphia was a four-page letter in folio, on official paper, signed by Lamarck as director of the Museum of Natural History and by Geoffroy as 'professor and secretary.' The writing is in the hand of Geoffroy, and it is, accordingly, fair to assume the composition and the doing into English were also his. The ideas, however, are subscribed to by Lamarck 'for director' in his characteristic hand.

One might add that manuscripts connected with Lamarck are rare; in fact, few are known which touch upon variation in species, and the present letter may, therefore, be quoted literatim, for what it contains of an extra philosophical nature will be at least of human interest as indicating the type of correspondence which such a man as Peale would have read to his colleagues of the Academy of Natural Sciences.

at Paris, 30 Juny 1796

LIBERTÉ, ÉGALITÉ, FRATERNITE.
MUSÉUM NATIONAL
D'HISTOIRE NATURELLE.

The Professors directors of the National Museum of Natural History To Mr. Peales, at Philadelphia.

*Sir,*

Mr. Beauvois has transmitted us the letter wich you directed to him, by wich you propose yoursel to enter into a correspondance with the Museum of Natural History of the french Nation. We are pleased to seize an opportunity wich can afford us some communication with a Naturalist of your merit. Every thing you announce is

agreable and will be equally useful on both sides. We shall send you with pleasure and care a collection of the European productions in exchange for the Americans, which your love for the science of Nature impels you to collect, be so kind as to correspond with us on this subject. The way by wich your letters and your sendings can reach us is simple. Direct your instructions to the Minister of the Marine of the french republique; marking on the direction that they are destined for the Museum of Natural History.

Give us leave, Sir, to call your attention on the subjects wich we desire to receive first. Those enormous bones wich are found in great quantity on the borders of the Ohio the exact knowledge of those objects is more important towards the theory of the earth, than is generally thought of. We ardently wish some couples of alive animals *à bourses* (Marsupialia, opossums). Their generation is too hypothetical. The french Naturalists wish to acquire at last a solid opinion on this important question, wich can throw a light on the generation in general. The scalpel may perhaps lead us to discover particular organs, wich have not yet been described, wich might afford us some new views.

We also desire some species of quadrupeds of your climate. they have some conformity with those of the ancient continent. they are even been confounded with one another. Neverthelss we think they differ as to their species; and to be assured of it positively we should be pleased to receive indistinctly* all those you could have gathered. We are about to proove that no species of the ancient continent exists in the new et vice versâ and that great proof founded in the contrary opinion by wich both continents were formerly united towards the north would fall as groundless.

Therefore it would be highly important to us to know the Bears of the Illinois the stags and Roe-bucks of Canada the stairs,† the mountain Rats (Marmottes) the weasels (Belettes) the Bats (Chauvre souris) the moles (taupes) the martes (les martes) the beavers (les Castors ou bievres) etc We should be grateful if you would join to these the animals of our own country wich have transmitted in our ships to your country, as the rats, the mouses the *sorex araneus* (mus araigne). It is incredible what variety these animals offer to the attentive eye. How many analogous forms are taken for Species. It would be interesting to know what degeneration their transplantation has produced on their economy. They would lead us to a more exact knowledge on the nature of the Species and even of the Species in general. Spiritous liquors are the best means of preserving of all those animals. by this mean we will acquire with respect to foreign animals all the most striking facts wich they offer to the observator. We know better their external form, their skeletton, their organes of nutrition, of respiration, of circulation, of generation; and to finish animals always arive in a good condition. It is the manner in wich we shall transmit to you all our animals, wether quadrupeds, or birds or insects if these animals are of a smale size unless you prefer the ordinary means.

* ? indiscriminately.

† ? Bison.

As to great animals whose preservation in spirituous liquor would be too dispendious,* we would be satisfied with the skins but for gods sake leave to the skin the scull and bones of the feet. We would be equally grateful if you would add to your envoys a skeleton separated from the great animals, whose form is different from that of those species well known in Europe, and to use the language of Naturalists a skeletton of each gender. We shall pay the same regard to you We shall not fail of sending you preparations as we wish them form you, convinced that it is to the progress of Natural History.

We already possess a sufficient quantity of smal birds from north America, however the list of those wanting in consulting the work of Catesby is considerable. you will find it with this letter. By this mean you will be informed that all the birds marked by Catesby wich are not inscribed on the list form a part of our precious collection and are less necessary than the others.

We wished, Sir, that our correspondance should not be confined to the exchanges of European productions with American only, be to kind as to make it litterary; send us the catalogue of all the works appearing on Natural History in the united States. Let us know the history of that science by your know corporations of learned men instituted to its progress. Depend on the reciprocation on our part. Inquire, Sir, after all the particulas; do not fear to swell your letter. I shall give it ful credit as much as it lays in my power. When the means shall be deficient, I shall write it to you with frankness.

Accept, Sir, the assurance of our estim and obedience.

LAMARCK
*for director.*

GEOFFROY
*Professor and Secretary of the Administration of the Museum of Natural History.*

* ? Expensive.

The obvious interest of the foregoing letter is in its testimony that the writers were keenly alert as to transformism at this early date (1796), and that they had even marked out an important line of inquiry—comparison of old world species with new world species, and a study of the variation of those forms which had been introduced and allowed to run wild for a considerable period, possibly a hundred years. In other words, they are seeking 'a more exact knowledge on the nature of the species and even of the species in general.' And they clearly assume the importance of evolution, when they aim to measure the amount of change (degeneration) which transplantation has caused in the economy of mammals. Especially conspicuous is the importance which is apparently attributed to the Buffonian factor: 'we also desire some species of quadrupeds from your *climates*.' "It is incredible what variety these animals offer to the attentive eye." There is even a crude notion of parallelism in the remark that 'many analogous forms are taken for species.' Noteworthy also is their interest in the paleontological evidence, for the bones from salt licks are expected to yield important evidence as to 'the theory of the earth.' And we may conclude that Lamarck had evidently his Hydrogéologie (1802) as well as transformism in mind in his search for evidences as to distinctness of species widely separated geographically when he theorizes as to the ancient outlines of continents, and maintains that no species of the ancient continent exist in the new.

The present paper, moreover, narrows the probability that Lamarck borrowed his transformism from Doctor Darwin. For Lamarck is not known to have had evolutional tendencies before about 1799, and it has accordingly been stated that the Zoonomia (1794) was the slowly working cause of his conversion. By the present evidence, moreover, he was enterprisingly investigating the nature and variability of species, as early as the spring of 1796, *i. e.*, less than two years after the publication of Darwin's work, and possibly before it was circulated abroad. Indeed, even in England there is little reference to it before 1798, and Paley's attack upon Darwinism did not appear till 1802. Of certain interest is the literary partnership of Lamarck and Geoffroy in philosophical matters at this early date. Geoffroy was then but twenty-four years of age, and this is, as far as I am aware, the earliest record of his interest in the origin of species. It antedates by several years his studies on the mummied fauna of Egypt; and we may naturally query whether he may not already have had in mind to test the possibilities of variation by comparison of the early and late 'productions' of the valley of the Nile before Napoleon had laid his plans for an actual invasion?

Bashford Dean.
Columbia University.

### THE NATURE OF THE PELÉE TOWER.

The recent publication of a note by Professor Lacroix (*Comptes Rendus*, March 20, 1904) on the production of quartziferous rocks in the course of the actual eruption of Mont Pelée, and the stated conclusion arrived at by the distinguished French geologist that rocks of this character (and by analogy, other igneous rocks of more clearly marked figure, such as microgranulite and even true granite) may be formed superficially and do not require in their construction deep-seated pressure—conditions which have long since been recognized, even if the processes of formation had not before been observed—afford, perhaps, a sufficient reason for me to state my belief that the giant obelisk of rock, which at the time of its greatest development, the close of May of last year, towered out of the crateral opening of the volcano to a height of nearly 1,000 feet (and, had there been no summit, breakages would probably have risen a full thousand feet higher), had *not* the structure that was assigned to it by Lacroix—namely, that it represented an exceedingly viscous acidic lava which solidified immediately on its extrusion and rose vertically under volcanic stress instead of flowing off in the manner of the normal lava-streams. This seemingly simple explanation of one of the most remarkable structural forms of the earth's surface has apparently been accepted by most geologists, and my own earlier studies led me to the same conclusion. A later critical examina-

tion, however, based upon considerations drawn from the form of the tower, the distinctly varying conditions of two opposed faces, the absence of fluidal overflow at any point, and the sharp line of demarkation that separated the base of the structure from the enveloping cone or dome (in which a true flow was plainly apparent, exemplifying the Georgios-Santorin dome of 1866 and the Vesuvian 'monticule' of 1895), and a review of the difficulties that stand in the way of the Lacroix explanation, forces upon me very strongly the impression that the tower was merely the ancient core of the volcano that had been loosened from its moorings and lifted bodily outward by the force of the volcano's activity. The whole appearance of the tower was much more suggestive of an ancient rock metamorphosed by heat (or steam) action than of a newly formed and rapidly solidified lava, and as early as August, 1902 (*McClure's Magazine*), when its extraordinary relations were still unknown, I referred to it (and others, likewise) as giving the aspect of 'burned-out cinder masses.' This view of the structure of the Pelée tower has, indeed, suggested itself as a possibility to other geologists, and I believe was held tentatively by some before I had myself seriously considered it; but at this time it does not seem to me that there can be much doubt as to its broad accuracy.

The lifting of giant rock-masses or mountain-cores through the crateral axis of a volcano is not entirely unknown, for it is now many years since Abich described, in his monumental work on Transcaucasia, the upheaved mass occupying a portion of the crateral wall of the Palandokän volcano; and a somewhat similar structure had been noted still earlier by Scrope in the Puy Chopine of the Auvergne. Neither of these structures was in any way comparable in magnitude with the Pelée tower, but their manner of uplift was not unlikely largely identical. The fact that most volcanoes 'plug' themselves after varying periods of activity, and that some of these reopen directly in the line of earlier eruptions, would in itself seem to suggest that from time to time extravasated plugs (neck-cores or towers) should appear at the surface, and I take it for granted that some, at least, of what have heretofore been considered as volcanic erosion-fragments are in reality merely structures of this kind. It can hardly be possible that upthrusts of this nature should not exist. Sir Richard Strachey has, indeed, called attention (in *Nature*) to numerous 'towers' or fingers occurring over the trap-flows of the Dekkan plateau, and he likens these (observed and sketched by him the better part of seventy years ago) to the Pelée excrescence. In how far the structures may or may not be identical only a new study of the Indian field can positively determine; but I believe that the Indian figures will be found to represent the extremely acute 'thumbs' and pinnacles which surmount the trap plateau of different parts of Greenland (Omenak Promontory, Disko Island), whose origin through erosion can not be questioned. Somewhat more doubtful may be the character of the (true) Devil's Thumb which marks the entrance to Melville Bay, and whose picture looms up in my mind very similar to that of Pelée's tower.

In this brief note it is impossible to enter into a discussion of the difficulties that oppose themselves to the generally accepted view of the structure of the Pelée tower; some of these will be more particularly referred to in a general paper which is about being sent to press. The view here expressed may lead to a better understanding of the relations of the ejected fragmental rock, the greater part of which, it seems to me, is from the old stock of the volcano, with the chemical and physical composition of which it so closely agrees.

Angelo Heilprin.

Philadelphia,
May 5, 1904.

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## CURRENT NOTES ON METEOROLOGY.

### A NEW SUNSHINE RECORDER.

In *Symons's Meteorological Magazine* for March, the new Dawson-Lander sunshine recorder is thus described. The instrument consists of a fixed drum, on which some silver chloride photographic printing paper is fastened, under a film of transparent celluloid. An outer cover is rotated by clock-work once

in twenty-four hours, and a narrow slit is thereby directed towards the sun. A hood, funnel-shaped, protects the slit from diffused light, and allows of an error of about half an hour in the clock before sunlight is cut off from the slit. The drum carrying the sensitive paper travels, without rotation, along the axis of the cylinder, so that the record of a number of days may be obtained, one below the other. The advantages of this instrument are as follows: The chloride of silver paper makes possible a standard of intensity of sunshine which can be reproduced; the same size of paper is used at all seasons, and the instrument is serviceable for the sunshine of polar as well as of temperate latitudes.

### CLIMATE OF CHILE.

A paper on 'The Economic Geography of Chile,' by J. Russell Smith, in the *Bulletin of the American Geographical Society*, XXXVI., 1904, 1–21, lays emphasis on the striking climatic contrasts between the northern desert provinces and the southern cool and rainy districts within the latitudes of the prevailing westerly winds. Between the deserts of the north and the forests of the south lie the agricultural regions of central Chile. Were it not for the mineral wealth, the great seaports and settlements of northern Chile would never have been developed, for the climatic conditions are distinctly hostile to human occupation. In the south, where the abundant rainfall favors the growth of trees, future deforestation will open the land more and more for settlement, but 'the economic center of gravity, and the home of four fifths or more of Chilean population, is, and must continue to be, in the central or agricultural region.' These large facts of the climatic control of settlement and occupation in Chile can not fail to impress themselves upon even the most casual observer who has the opportunity, which in 1897 came to the compiler of these notes, of making a climatic cross-section along the west coast of South America by taking the voyage from the Straits of Magellan to Panama.

### MOUNTAIN SICKNESS.

In Mr. D. W. Freshfield's book, 'Round Kangchenjunga,' it appears that those persons who suffered from mountain sickness were most affected between 15,000 and 16,000 feet, and that there was no increase of symptoms up to 20,000 feet. One member of the party 'had a constitution on which the only effect of altitudes of 20,000 feet was to increase his appetite and consequently his weight.' Mr. Freshfield was able to walk from 13,000 to 16,000 feet without halting, and sees no obstacle, so far as the physiological effects of diminished pressure are concerned, to an ascent of loftier mountains than Kangchenjunga.

### WRECKS AND CASUALTIES ON THE GREAT LAKES IN 1903.

According to the 'Meteorological Chart of the Great Lakes, Summary for the Season of 1903,' by A. J. Henry and N. B. Conger (Weather Bureau No. 298, 1904), twenty-four vessels became total losses through stress of weather. The loss due to fog was $277,500. The number of lives lost through stormy weather was forty-nine. R. DeC. Ward.

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## *PROGRESS OF THE CONCILIUM BIBLIOGRAPHICUM.*

Dr. Herbert Haviland Field, director of the Concilium, sends us an advance copy of his report, the most encouraging by far which he has been able to issue.

The number of cards issued since the foundation of the Concilium is 12,942,000.

The principal features of the progress of the past year are set forth in this very interesting report.

Of especial interest to Americans is the establishment of a set of the complete reference catalogue in the public room of the American Museum of Natural History, where it will not only be accessible to students, but from which immediate orders can be filled. This arrangement has been brought about by conference between the director of the concilium and Director Bumpus of the museum.

CONCILIUM BIBLIOGRAPHICUM (ZÜRICH, SWITZERLAND). GENERAL STATEMENT FOR 1903.

The present year has been a memorable one in the annals of the concilium. For the first time since the foundation of the work, the director has been able to renew personal relations with the great body of American zoologists and librarians. In Washington, Baltimore, Philadelphia, Princeton, New York, Woods Hole and Boston, an endeavor was made to gather suggestions and impressions from all possible sources; technical methods and devices were studied, and the firm conviction was obtained that the concilium may count on the support of American men of science. Not a trace of adverse criticism came to our ears, nothing but unqualified approval. It was particularly gratifying to see the many unforeseen applications of our classificatory system in zoological institutes and in libraries, large and small. In short, in this land, where the readiness to accept all innovations that are really practical is proverbial, we met an unexpected warmth of approval. Through a communication made in the Library Congress, and through numerous visits, the opinions of the leading librarians and bibliographers were also gathered. Here again there was unanimity, or rather, to be exact, unanimity less one dissenting voice.

The most noteworthy testimonial encountered in America was the offer of the American Museum of Natural History to patronize the work. This institution purchases the most complete set of cards obtainable, including the card catalogue of new species, etc. In addition, a complete collection of the main bibliography will be deposited in its library for distribution to those desiring to receive references to any special topic. Whenever information is desired, the cards may be obtained from the museum at the same terms as from Zürich and the cards thus withdrawn will be replenished as soon as possible.

Another important step taken in 1903 has been the reunion of the card catalogue with the *Zoolog. Anzeiger*. The concilium is thus called upon to continue a bibliography which forms an unbroken sequence since the year 1700. This circumstance gives to the concilium a unique position among the bibliographical enterprises of the world and makes it doubly the duty of biologists to aid the institution in its work.

The circumstances attending the transfer of the editorship of the bibliography of the *Zoolog. Anzeiger* to our hands were unfortunate in the extreme. We had no means of knowing what had been done and what remained to be done. Old illegible manuscript had to be utilized and a new organization created in the absence of the director of the concilium. The product was most unsatisfactory, and yet the time spent on the work was such as to hamper our entire activity and occasion serious financial loss. Now, however, the principal difficulties are removed and the work promises scientific success even though the arrangement be of little financial benefit to the concilium.

The report for 1903 would be incomplete without a tribute to the memory of Professor J. Victor Carus, late editor of the *Zoolog. Anzeiger*. A zoologist of the old school familiar with the science in all its ramifications, he also brought to the work profound classical learning, a rare knowledge of languages, a fine sense of order and proportions and a passion for hard work, which seemed almost incredible. Prevented by ill health from following an active career, he devoted his life to bibliography. Even in the last years, this feeble octogenarian sat whole days at his desk and prepared in his fine cramped handwriting the 10,000 titles that were sent yearly to press. No one who has never tried it can know what that means. To have done this for a lifetime seems beyond the powers of human endurance. But in spite of all this routine, it is to the added credit of Professor Carus that his mind was ever open to new ideas. Just as in his scientific career he became an ardent convert to Darwinism and took foremost place in making the works of Darwin accessible to his countrymen, so in later years he seized with avidity the new ideas in bibliography which the founding of the concilium made prominent and began the transformation of his bibliography in accordance with them.

With equal vigor, the old master of bibli-

ography felt himself, however, called upon to denounce an enterprise which, breaking with all sound bibliographical traditions, sought to evolve around the diplomatic green table a plan for a vast and disordered compilation, which through the simple fact of financial superiority was to supplant the product of all the individual labor of which Professor Carus offered in his own life the noblest example. It is not too much to say that this contemptuous neglect cast a deep shadow over the last years of his life. He lived, however, long enough to see his contention justified by events and to be freed, as he expressed it, from a dreadful nightmare.

Financially the year closed with a deficit, which, in view of the complications of the year, was quite inevitable. Fortunately, the American Association for the Advancement of Science and the Elizabeth Thompson Science Fund again came to the rescue. It has been generally taken for granted that the petition of the American Society of Naturalists and the American Association ensured favorable action on our request for adequate aid from the Carnegie Institution; but in spite of endorsement by the zoological advisory committee, no grant has been awarded. We are, therefore, again forced to make a strenuous appeal to private generosity.

The public expressions of approval of our work have been even more numerous in the past year than in those that have preceded. Besides the resolutions of the societies above mentioned and the discussion at the Library Congress, we may mention the articles published by Mr. Van den Broeck in which he declares that the work of the concilium is the ideal which other enterprises must endeavor to attain. In the ensuing correspondence, a plan for enlarging the scope of the concilium towards geology was elaborated, and could be realized if the necessary funds were forthcoming.

At the congress of the International Association of Botanists held in Leiden in April, a day was given to the discussion of a project of forming a botanical section of the concilium, and resolutions were unanimously passed advocating such action and offering as a contribution to the section the same sum that the association had hitherto devoted to its own bibliography. This offer was accepted by the concilium, to take effect as soon as an equal sum from some other source should be obtainable. The committee of the association has generously left the entire question open for a year pending the endeavor to obtain adequate support for the concilium.

During the summer of 1903, an international congress of forestry took up the question of bibliography and appointed a committee to consider the question of founding a bibliography in connection with the concilium. This action, of which we had no knowledge in advance, shows how far our work is being appreciated. The international committee is to meet soon in Zürich.

Arrangements have been perfected for the organization of a new bibliography in connection with the *Archiv für Rassen- und Gesellschaftsbiologie.* This bibliography will be the beginning of the realization of the plans for an exhaustive treatment of anthropology.

A promising project of extending the activity of the concilium to certain applications of science has been quite unexpectedly brought to us. One of the workers in the concilium is devoting himself to it.

The close of the year has finally seen the opening of a series of negotiations of great importance for the future organization of scientific bibliography, and which all tend to bring existing bibliographies one by one into harmony with our work. Though unsought by us, this new tendency is certainly to the advantage of all parties concerned and in the interest of science.

Further evidence of the reputation which the concilium has won is to be found in the great increase in the number of publications sent to this office for notice. With scientific societies this practice has become quite general and publishers are rapidly following the example.

Besides the innovations to which allusion has been made in the preceding pages, three new publications will be undertaken in 1904.

One of these will be a list of the journals

which have been excerpted for the bibliography.

| | 1896–98 | 1899 | 1900 | 1901 | 1902 | 1903 | Total. |
|---|---|---|---|---|---|---|---|
| (*A*) Subject Index. | | | | | | | |
| 1. Paleontology | 1,460 | 1,840 | 2,662 | 2,035 | 1,436 | 2,170 | 11,603 |
| 2. General biology | 187 | 151 | 92 | 155 | 93 | 200 | 878 |
| 3. Microscopy, etc. | 266 | 132 | 249 | 263 | 107 | 169 | 1,186 |
| 4. Zoology | 18,845 | 14,271 | 13,326 | 16,845 | 11,059 | 11,..... | 85,..... |
| 5. Anatomy | 1,940 | 936 | 1,875 | 2,007 | 1,224 | 1,5... | 9,5... |
| 6. Physiology | 1,380 | 1,270 | 433 | — | — | — | 3,083 |
| Total | 24,078 | 18,600 | 18,637 | 21,305 | 13,919 | 15,2... | 111,7... |
| (*B*) Authors' Index. | 16,165 | 9,492 | 10,890 | 10,119 | 6,727 | 7,..... | 60,..... |
| Total | 40,243 | 28,092 | 29,527 | 31,424 | 20,646 | 23,..... | 173,..... |

Another is a card catalogue of all new names of generic or subgeneric rank which have been proposed in paleontology or in zoology since January 1, 1901. Each name will be given two entries, one under the appropriate taxonomic heading, the other in alphabetical arrangement. The price per card of the new catalogue will be double the usual tariff.

The third new publication is that relating to comparative physiology, in regard to which a special circular has been prepared.

Sooner than we expected, our quarters have become too small for storing our rapidly growing collection; but relief has been found for the overflow in a neighboring house.

The following table shows the total number of entries in a complete set of cards arranged by subjects and by authors. The years refer to the date of publication of the cards.

*Distribution by Topics.*—The distribution of primary cards in the chief divisions of the bibliography is shown in the following tables. Our statistics are, however, merely approximate, the earlier cards of the complete series being now quite out of print. The 'complete set' as understood by us can best be explained by an example. Subscribers to the complete set have thus far received 134 cards in the division 'Fauna of Sumatra.' This same division of the systematic set contains a single reference (Moesch: 'Nach und aus dem Pfefferlande'). This contribution appeared to us too general for us to cite it under any particular systematic group and it was classed under Sumatra in general; the remaining 133 references deal with individual groups of animals found in Sumatra, as, *e. g.*, Hispidæ or Lemoniidæ. In the 'systematic set,' they are entered under Hispidæ, Lemoniidæ, etc.

## *SCIENTIFIC NOTES AND NEWS.*

MR. F. A. LUCAS, curator of the Division of Comparative Anatomy of the U. S. National Museum, has been appointed curator in chief of the Museum of the Brooklyn Institute of Arts and Sciences. Mr. Lucas succeeds Mr. Alfred G. Mayer, who, as we have already announced, has been appointed curator of the Marine Laboratory of the Carnegie Institution at Tortugas, Florida.

SIR DAVID GILL, director of the Observatory of the Cape of Good Hope, has been elected honorary member of the Finnish Academy of Sciences.

THE French Geographical Society, at its general meeting on April 22, conferred gold medals on Dr. Sven Hedin and Captain Lenfant.

THE Council of the British Institution of Civil Engineers has made the following awards for papers read and discussed before the institution during the past session: A Telford gold medal to Major Sir Robert Hanbury Brown; a George Stephenson gold medal to Mr. G. H. Stephens, C.M.G.; and a Watt gold medal to Mr. Alphonse Steiger; Telford premiums to Mr. E. W. De Rusett, Dr. Hugh Robert Mill, Mr. Alexander Millar, and Mr. T. E. Stanton; a Manby premium to Professor J. Campbell Brown; and a Crampton prize to Mr. L. H. Savile.

The Iron and Steel Institute of Great Britain held its twenty-fifth annual meeting at London on May 6 and 7. Mr. Andrew Carnegie presided. The Bessemer gold medal for 1903 was presented to Sir James Kitson, M.P., past president, in recognition of his conspicuous services in the advancement of the metallurgy of iron and steel. The Andrew Carnegie gold medal for 1903 was awarded to Mr. Alfred Champion of Coopers Hill for researches in the heat treatment of steel under conditions of steelworks practise. A special medal was also awarded to Dr. O. Boudonard, of Paris, in recognition of the merits of his research on the determination of the points of allotropic changes of iron. Four Carnegie research scholarships of the value of £100, tenable for one year, were awarded respectively to C. O. Bannister (London), to P. Breuil (Paris), to K. A. Gunnar Dillner in conjunction with A. F. Enström (Stockholm), and to J. C. Gardner (Middlesbrough). Further grants were also made to A. Campion and to P. Longmuir (Sheffield). The Bessemer gold medal for 1904 was presented to Mr. Roberts A. Hadfield, vice-president, in recognition of his great services to the metallurgy of iron and steel. The Andrew Carnegie gold medal for 1904 was awarded to M. Pierre Breuil, of Paris, and a special silver medal was awarded to Mr. Percy Longmuir, of Sheffield.

At the annual meeting of the Royal Institution on May 2, officers were elected as follows: *President,* the Duke of Northumberland; *treasurer,* Sir James Crichton-Browne; *secretary,* Sir William Crookes; *managers,* Dr. Henry E. Armstrong, Sir William Abney, Mr. Shelford Bidwell, Sir Alexander Binnie, Mr. J. H. Balfour Browne, K.C., the Hon. Sir Henry Burton Buckley, Sir Thomas A. De la Rue, Dr. J. A. Fleming, Sir Victor Horsley, Lord Kelvin, Dr. Ludwig Mond, Sir Owen Roberts, Sir Thomas Henry Sanderson, Sir Felix Semon and Mr. W. H. Spottiswoode.

Professor E. B. Wilson, of Columbia University, has sailed for Europe to continue his researches at the Naples Zoological Station.

Professor Ernst Haeckel, who recently celebrated his seventieth birthday in Italy, has returned to Jena and has resumed his lectures.

We learn from *The Observatory* that Dr. W. Doberck has returned to Hong Kong Observatory after a period of leave in Europe on account of his health. His assistant, Mr. Figg, is now coming to England for a year or two.

An Astronomical Society has been founded at Newcastle on Tyne with Mr. P. E. Espin as the first president.

Edward W. Berry has been elected recording secretary of the Torrey Botanical Club in the place of Professor F. S. Earle, who has resigned to accept a scientific position in Cuba.

Miss Eugenia Metzger, M.D., assistant in physiology at the University of Missouri, has been appointed to the woman's table at the Zoological Station at Naples for the months of June, July and August.

The first field party of the U. S. Geological Survey to leave Washington this year is, as usual, the Alaskan contingent. During the past winter, congress increased its appropriation for Alaskan work from $60,000 to $80,000. Nine parties will be engaged there during the coming season in topographic and geologic work. Besides these, three subparties, which may be counted as offshoots of the larger ones, will take up special work, so that the number of survey investigations in Alaska during the summer will be twelve as compared with seven of last year. Among those taking part in the work are Mr. A. H. Brooks, Mr. C. W. Wright, Mr. F. W. Wright, Mr. F. H. Moffit, Dr. T. W. Stanton, Mr. A. G. Collier, Mr. L. M. Prindle and Mr. C. W. Purrington.

Professor G. H. Parker, of Harvard University, has given at the Brooklyn Institute of Arts and Sciences a course of six lectures on 'Human Sense Organs and their Evolution.'

The Horticultural Society of New York held its sixth annual meeting at the New York Botanical Garden on May 11. At the conclusion of the business meeting an illustrated lecture on 'Common Trees and their Uncommon Flowers' was given by Mr. J.

Horace McFarland. There was an exhibition of plants and flowers.

THE Brooklyn Institute of Arts and Sciences held, on May 10, a memorial meeting in honor of Herbert Spencer, the principal address being made by President J. G. Schurman, of Cornell University.

A COMMITTEE has been formed to prepare a memorial of the late Leslie Stephen, which in the first instance will consist of an engraving of a portrait by Mr. Watts, which will be presented to institutions with which Sir Leslie Stephen was closely associated.

PROFESSOR A. W. WILLIAMSON, F.R.S., the eminent British chemist, died on May 6, at the age of eighty years.

WE regret also to record the death of Sir Henry M. Stanley, the African explorer, of M. Leidie, professor of chemistry at Paris, and of Dr. W. Thiermann, lecturer on applied electricity at the Technical School at Hamburg.

THE annual conversazione of the Royal Society was held on May 13.

THERE will be a civil service examination on June 16 to fill the position of laboratory aid in physiology and pathology in the Department of Agriculture at a salary of $720.

THE government of Iceland has appropriated about $10,000 a year for twenty years to establish wireless telegraphic connection with Great Britain and between the towns of Iceland.

UNDER date of March 8, 1904, U. S. Consul H. L. Washington, of Geneva, reports that during the month of February the advance in piercing of the Simplon Tunnel was only 15 feet 7 inches per each working-day, and this work was entirely on the southern side. The tunneling work in the gallery on the northern side had not been resumed. In each of the two galleries a system of safety doors was being placed to lessen the effect of floods that may be caused by the springs. These doors would be completed about the middle of March and the mechanical boring would not be resumed until then in both galleries. At the end of February, 1904, a little more than 11.295 miles had been drilled, leaving 0.964 mile to be tunneled.

MR. ARCHIBALD ROGERS, a member of the board of trustees of the American Museum of Natural History, has presented to the museum an exceptionally perfect copy of the first edition of Audubon's 'Birds of the United States of America.' It is believed that not more than 175 copies of this edition of 'Audubon' are now in existence, of which about one half are thought to be in this country. Published in 87 parts at ten dollars each, the work is now valued at $3,000.

MR. MAX J. BAEHR, consul at Cienfuegos, writes to the Department of State in reference to the use of the metric system in Cuba, stating that it is established by law and is adopted in all transactions at the customhouse, city hall, and in the registry and records of property; in fact, it is compulsory and adhered to in all official acts. In groceries, all solid goods are sold by the ounce and pound, the United States pound being used, as the scales are mostly of American manufacture, a few only being imported from Germany. Liquors are usually sold at wholesale in original packages and at retail by the bottle or fraction of a bottle, the poor people sometimes buying a few cents' worth. The country's products, such as cereals, are sold by the pound or fraction thereof, except that corn when sold in ears is sold by the fanega, which is 1,000 ears of corn. Vegetables are generally sold by the pound, the arroba, or 25 pounds. Cabbages and bananas are sold in numbers from one up to one hundred or more. Civil engineers and land surveyors employ the metric system throughout their measurements. Mechanics in general make use of English inches as their unit measure.

THE next meeting of the Museums Association will be held at Norwich, during July 14 to 17, under the presidency of Dr. Sydney Harmer, F.R.S., keeper of the Museum of Zoology at Cambridge University. The membership of the association has increased so greatly of recent years that a large attendance is expected. We are asked to state that American visitors will be particularly welcome. Further information may be obtained from the secretary, E. Howarth, Public Museum, Sheffield, England.

Under date of March 3, 1901, it was announced that 'in order to further the laboratory instruction of large classes of students, Professor W. T. Porter would undertake to provide reliable physiological apparatus constructed under his personal supervision.' During the past three years such apparatus has been made by the mechanics of the Harvard Laboratory of Physiology. The demand for this apparatus now warrants a more systematic provision for its manufacture. Professor Porter therefore announces the formation of The Harvard Apparatus Company, organized for the advancement of laboratory teaching in physiology and allied sciences. This company will manufacture physiological apparatus of simple design, sound workmanship, and low cost, suitable for laboratory teaching and for research.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

Governor Odell has signed the bill appropriating $250,000 for the erection of a building for the College of Agriculture at Cornell University.

The corporation of the Massachusetts Institute of Technology voted that the executive committee be required to ascertain whether any arrangement can be made with Harvard University for a combination of effort in technical education such as will substantially preserve the organization, control, traditions and name of the Massachusetts Institute of Technology.

Eugene N. Foss has given $50,000 to the University of Vermont for the $1,000,000 fund which the graduates of that college are trying to raise to mark the centenary of the institution.

The will of the late Solomon Loeb, of New York City, gives more than $100,000 to public purposes, including $10,000 for the Chemical Laboratory of the New York University, $10,000 for the Hebrew Technical Institute and $5,000 to the American Museum of Natural History.

The University of Turin has recently celebrated the five hundredth anniversary of its foundation.

Denison University has secured a ten-year lease on a small plot of ground adjacent to the campus containing a fine permanent spring for a biological farm. The lease has been donated by a friend, also a fund for equipment, both amounting to $500. A small work room and open-air breeding pools with running water have been built and enclosed with netting.

King Edward laid the cornerstone for the new buildings of the Royal College of Science, Dublin, on May 28.

Professor Charles S. Howe was inaugurated as president of Case School of Applied Science, at Cleveland, Ohio, on May 11. President Ira Remsen, of Johns Hopkins University, spoke in behalf of the universities; President H. S. Pritchett, of the Massachusetts Institute of Technology, on behalf of the technical schools; John R. Freeman, of the American Society of Mechanical Engineers, on behalf of the technical societies; and President Charles Franklin Thwing, of Western Reserve University, on behalf of the colleges of Ohio. President Howe's inaugural address followed.

Dr. Maxime Bôcher, now assistant professor, has been appointed professor of mathematics at Harvard University. Dr. Edward D. Peters has been appointed professor of metallurgy.

Dr. A. C. Kerr has been promoted to a professorship of anatomy at Cornell University, and has been made secretary of the Ithaca Division of the Medical College.

Dr. Oskar Zoth, professor of physiology at Innsbrück, has accepted a call to the University of Graz.

At Williams College, Dr. Frederick H. Howard has been promoted to an assistant professorship in the department of anatomy and physiology.

Mr. J. O. Griffiths, B.A., late scholar of Balliol College, Oxford, has been elected to an ordinary fellowship after examination in mathematics and physics.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MAY 27, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE AMERICAN SOCIETY OF NATURALISTS. WHAT ACADEMIC DEGREES SHOULD BE CONFERRED FOR SCIENTIFIC WORK?**

THE CHAIRMAN (PROFESSOR TRELEASE):

The subject that has been selected for the afternoon's discussion is one of very considerable interest to all of us as investigators, and further, to those of us who are teachers as well—the question as to what academic degrees should be conferred for scientific work. From the time when one of our little people comes home from the primary school with a long narrow strip of yellow paper with various hieroglyphics on it that he has made himself, and with certain blue pencil marks which may read 100, or 90, or 40, we are confronted by one phase of the question that we are to analyze this afternoon. The arithmetical grading of our attainments and our personality begins at the very moment that we go into the kindergarten, and it does not end until a well-disposed clergyman tries to find something good to say of the worst of us when we are through with our life's work. Everywhere between the kindergarten and the grave we are confronted with the fact that a kind of stamp is put upon us in every one of the complications of life that we may fall into.

What are we trying to do as teachers is of course perfectly clear to every one of us. Those of us who are teachers are trying to equip people for useful work in life. The situation is not unlike that of cur-

* Annual discussion, St. Louis meeting, December, 1903. Reported stenographically and corrected by the speakers.

rency in China. I had the pleasure a few weeks ago of listening to a very instructive address on Chinese banking by a scholarly native of that country, who reminded us of the time, in the seventies, when one of our New England firms thought that it would be a very nice thing to take over a lot of trade dollars—a thousand or more, to China, in order that the good standard coin, stamped with the sign manual of a good responsible nation, might be passed into the Chinese circulation, but he stated that before these trade dollars had been in China a month they were all melted down into bullion and the bullion was cast into the 'shoes' current in China—stamped with the imprint of the firms which chose to make them up in this form and guarantee their purity and weight. Now I take it that in this matter of the stamp of educational institutions we are really dealing with the same kind of currency question. Those of us who are called on to train men are turned to for an expression of opinion as to what those men are worth, and whatever that expression of opinion may be, and the value of it, are largely a matter of the convenience of the people our men may be thrown in with afterwards. I think we recognize that all of the percentage gradings, and all of the academic distinctions and classifications, and all of the honors that come in middle and old age, are merely expressions of belief; that the real thing we are trying to do is to make men useful, and that all marks of approval are merely secondary, accessory matters.

If we are agreed on this, however, I think that we are agreed that although evils, they are for the time being necessary evils. It does seem necessary that there should be a good deal of this vouching for people. With the greater complexity of our civilization and of our educational institutions, it becomes more and more necessary, apparently, that there shall be some of this sort of secondary designation, other than that which men can give themselves by going into the market and performing life's work; and for that reason we have this very question of degrees standing out prominently before us as investigators and teachers.

The subject that is before us this afternoon is one that can be made a very fruitful subject of discussion, not with reference to any action that the American Society of Naturalists may take in regard to it, not, perhaps, with reference to individual action that any society may take, but that through discussion some of the undesirable features of the present practise may in time be remodeled and replaced by a greater simplicity, and with a greater expressiveness, perhaps, in what is done.

With this preface to the work before us, I wish to call upon the first of the speakers who have agreed to take part in the discussion this afternoon, President Jordan of Stanford University.

Dr. Jordan:

Mr. Chairman, I was rather hoping that somebody that did not agree with us would come in between you and me, so that I might have something to stir me up to a little enthusiasm, something that would remind us of the old times when Professor Coulter and I fought on the bloody sands of Indiana against most of the other schoolmen of that state.

I have felt in regard to degrees very much as Caligula did when he said that he wished the Roman people had but one neck, so that he could despatch it with one blow. I have felt that it might be well if the degrees could be unified, and, taking them all together, we could abolish them at one blow. But doubtless, as the president has said, the degree is among the necessary evils of our time. Certainly no one institution could abolish degrees without distinct

disadvantage to its students, putting them in the position of eternally apologizing for the fact that they have no degree. The essential matter in regard to degrees, which should always be kept in mind, is that the student should not go out of his way to get a degree. It is a crime in education to force a student to do something that is not the best thing for him, merely to conform to some system. The individual is a thousand times more important than the system. Our work as teachers is really the work of training individuals, not to make them conform to a system unless the system helps on their work. In all of our treatment of degrees we should keep that principle in mind—that the student ought not to go out of his best way. How that best way is to be judged is another question, but there is always one way better than other ways for each particular man.

I believe also that the degree should not be made too much of, and that we should not regard it as something particularly vital. It is simply a handy term for the registration of alumni. I do not believe in making the degree a class label. One reason for separating the degree of A.B. from other bachelors' degrees has been the supposed superiority of the men of classical training. If the classical graduate is really superior, the fact will show. If he is not superior except in name, the assumption that he is so would tend to make him ridiculous. We know as a matter of fact that there is no superiority of classical training over other forms of training for all classes of men. We know that there is no kind of training better for all men than every other form.

I believe very strongly that it is best as a matter of policy for an institution to give the same bachelor's degree for all kinds of academic work that may be approved, whether it be scientific, or classical, or literary, or historical, or whatever it may be. Let the four years' course be marked by the degree of bachelor of arts—of arts because that term is one of long standing, long used in connection with college graduation. Its historic meaning is long since lost, and does not concern us vitally. Of course, the classical course of to-day is not the course of a hundred years ago. There is no historical value to the A.B. There are good reasons why the graduates of one institution should bear the same title. If one wishes to be more explicit, it is easy to specify on the diploma which has been the major subject.

As we know, the degree of B.S. has been and is grossly abused. It is given for short courses on insufficient preparation. It usually means bachelor of surfaces instead of bachelor of science, indicating that the bearer of it has none but superficial knowledge.

The degree of A.M. is a harmless one which means nothing in this country. In some institutions it costs five dollars, in some others two years of study. In some universities it is a step toward the degree of doctor of philosophy, and in other places it is a name for culture work of some kind or for training as a high-school teacher. We had a discussion in the Association of American Universities a while ago, spending several hours on the meaning of the master's degree. The discussion seemed to show very clearly that the degree had no uniform significance. On the average it was simply a convenient way to bring graduate students from other institutions into the roll of alumni of an institution in which they had done advanced work.

The degree which has most significance is that of Ph.D., one which we have brought from Germany. This is essentially a professional degree, the degree of the professional scholar, the professional investigator, as distinguished from the men who are not making their scholarship a profession. Professional degrees are the only ones with

permanent significance and the professional degree of doctor of philosophy should find its cognate in doctor of medicine, and the professional degree of law. Scientific degrees should be called by the same name as any corresponding degrees in scholarship. We should not attempt to split up our courses, separating scientific men from the other men. I think any distinction by way of degrees and badges is rather unfortunate, but that we should grant to all persons with high scholarship the same names and titles so far as these have any value at all. At present professional degrees have very different values. Some are university degrees, representing the professional training of an educated man, and some are trade degrees, showing that a man with or without education has attended lectures and learned something of the trade. The professional schools of some of our universities say: "There are so many men going to be doctors, or lawyers, willing to enter the study of medicine or law at such and such a time for such and such a period. We will take them for what they are and do the best we can for them." The university of higher aims seeks for the best way to train a good physician or lawyer and requires its students to take that kind of training. So long as we have professional schools fitted for such different classes of students, and still lower for persons who can not be called students at all, we shall have a great difference in the value of professional degrees.

I may repeat that I believe that the policy of Johns Hopkins, Harvard, Cornell, and many other institutions, the policy of unifying degrees, by getting rid of superfluous ones, is a movement in the right direction. We do not need more than two non-professional degrees, A.B. and A.M., and the Ph.D. should go along with the other doctors as a professional degree.

The Chairman:

I have several letters on the table, and before calling on the next speaker, I think that in view of what President Jordan has said, this letter from President Eliot of Harvard will be very interesting to you.

In reply to your inquiry of November 18, I beg to state that in my opinion, the best degrees to confer for scientific work, as for all other work, are the degree of bachelor of arts, the degree of master of arts and the degree of doctor of philosophy. In a temporary and provisional way the inferior degrees of bachelor of science, master of science and doctor of science have been used—with some variations of name and corresponding letters—in our country, because the preparatory work at school required of candidates for these degrees has been smaller in amount and inferior in quality than the work required of candidates for the traditional degree of bachelor of arts. This relative inferiority of the scientific degrees now begins to be overcome. When it is overcome there will be no reason for persisting in the special degrees which have the word 'science' in their title. More and more the equal dignity and value of the scientific subjects in comparison with the humanities is recognized. When that recognition is complete and universal, there will be no need of giving one degree for excellence in languages, history or philosophy, and a different degree for excellence in economics, architecture, chemistry or zoology. All good work, in whatever field, ought to be rewarded by the same academic distinctions.

For these reasons I consider separate degrees for scientific work to be undesirable, although provisionally necessary. They have heretofore been degrees of lower standing or repute, and they are likely to continue to be so regarded. I hope that they tend to be abolished. Will you kindly accept this statement as my contribution to the forthcoming discussion before the American Society of Naturalists?

The next of the gentlemen who have agreed to speak this afternoon is President Van Hise of the University of Wisconsin.

President Van Hise:

In considering the subject of degrees, I have thought rather of the trend of development than of what might seem desirable. As all are aware, the A.B. degree

was that of the classical colleges. The B.S. degree arose, as President Eliot has said in his letter, because those interested in the studies leading to the A.B. degree were not willing to accept work in science as equivalent to the traditional curriculum. It is comparatively recently that science work has been generally recognized as of equal cultural value with mathematical and classical studies; only recently that many institutions have come to the point of placing all liberal studies upon the same basis with reference to the A.B. degree. This came about when it was seen either that there must be a degree for every group of studies, or one degree for any group of liberal studies. This was not at first appreciated, and various degrees were introduced for different groups of studies. But when the logical result of this practise was understood, various institutions turned to the A.B. degree for all work of a general cultural nature.

But President Eliot holds that courses in chemistry, architecture, and by implication all courses in applied science, should also receive the A.B. degree. I do not know that I am prepared to go so far as to say that technical training in applied science should lead to this degree. Certainly recent development in this country has not been in this direction. It is now the practise, at least at many large technical institutions, to give the B.S. degree in applied science. This is illustrated by the Massachusetts Institute of Technology.

Applied science is taught in a somewhat different way, with a different spirit and a different purpose from the general cultural studies of the college of liberal arts. Feeling this difference, various institutions which have gone so far as to give the A.B. degree for all pure cultural work, including science, still give the B.S. degree for applied science. It is at least a question whether there is not a sufficient difference in the method and purpose of the college of liberal arts and the college of applied science to warrant a distinction in the degrees conferred by them. Certainly the colleges of applied science are generally using the B.S. degree. They wish to retain it as a stamp showing that their men are trained in science to a definite end. They do not desire the A.B. degree for the courses in applied science, since they feel that this degree does not express what they desire to say in reference to graduates of agriculture and engineering. It, therefore, appears to me that, for the present at least, the use of the two degrees mentioned is pretty well fixed in this country, *i. e.,* the A.B. degree for courses in the liberal arts and the B.S. degree for applied science.

If for all work in liberal arts the baccalaureate degree is A.B., then for advanced graduate work of a grade showing power of productive scholarship and investigation there should be a single degree, and for this place the degree Ph.D. is preferable, since it is the one in common use both in Germany and this country.

THE CHAIRMAN:

These letters that I have seem to fall in very nicely with the speakers this afternoon. I have a letter from President Schurman of Cornell which I will read now, if I may, as being quite appropriate to the remarks of President Van Hise.

It seems to me that the whole question depends entirely upon the point of view from which one looks at it. A distinction might also be drawn, I believe, between baccalureate and advanced degrees.

If we are to consider, as I believe we should, that graduation from the college of arts and sciences (or corresponding department) of a university signifies, regardless of the nature of the studies pursued previous to such graduation, the attainment of a certain stage of liberal culture rather than the completion of a course of preparation for a specific walk in life, then, it seems

to me, this training is best represented by the degrees of A.B. If, on the other hand, it is desired that the nature of the undergraduate studies shall be specifically shown by the name of the degree, I should think that the nomenclature, B.S., were as satisfactory as any for work in science.

Graduate work, however, is primarily specialization, and, as such, might very well be represented by degrees significant in themselves of the nature of the field covered, although here at Cornell the only advanced degrees now granted by the college of arts and sciences are A.M. and Ph.D. In that case, M.S. and D.Sc. seem to be very appropriate for work in science.

In other words, the line of argument that President Van Hise has presented seems to have been followed by Dr. Schurman.

As the next speaker, I shall call on Professor Cattell.

Professor Cattell:

President Jordan has told us that academic degrees belong to the babyhood of culture, and President Butler has elsewhere called them the tinsel of education. These university presidents, however, continue to confer degrees. They doubtless realize that our civilization is semi-barbarous, crude personal adornment being an important factor. It is, perhaps, a sign of progress to put rings through the ears rather than through the nose; if stays must be worn, those should be chosen that interfere as little as may be with the digestive processes. I should like to see academic degrees abolished altogether, or as a second choice to see the B.A. degree interpreted as meaning either bachelor of arts or bachelor of athletics, as the case may be, and then conferred on each college student when he attains his twenty-first birthday. But no individual and no body of individuals can create a new world; we may try to improve existing conditions, but must at the same time adjust ourselves to them. The question before us is not whether degrees should be abolished, but what kinds of degrees should be conferred for scientific work.

There are four kinds of degrees to be considered—those conferred at the close of the college course, those conferred for graduate studies, those conferred for professional work—all of which are more or less confluent, and lastly the degrees conferred as honors. The American college has performed an important service for the country and deserves the esteem and affection in which it is held. But its functions were local and temporary. We can scarcely imagine its introduction into Germany or France; or its survival here to the end of the twentieth century. The high school will give, and in fact now gives, the general training of the first year or two of the old college course, and after this comes the special training of the university and professional school. A kind of country club for young gentlemen of wealth and leisure is scarcely appropriate to a democratic community. We shall probably give the baccalaureate degree at the close of the school course as in France or abandon it as in Germany.

In the meanwhile what kind of a degree should be given for non-professional scientific work? The choice is apparently between the bachelor of arts and the bachelor of science. If there were exactly two kinds of secondary school and college courses, one based on the classical languages and one on the sciences, it would be proper to give to each its appropriate degree. But such clear-cut courses do not exist. According to the last report at hand, there were at Harvard College 249 elections in Greek and 303 in Latin. Those who elected Greek nearly all elected Latin, and there were not in the twenty-four courses in the classical languages as many different students as in a single course in history, economics or geology. One course in Latin given by three professors, one adjunct professor and

one instructor was attended by three students. There were about two thousand students in the college, electing about ten thousand courses, and the classical languages represented about one twentieth part of the average college education of the Harvard bachelor of arts. This degree means that the student studied Latin at the secondary school, not that he followed a different course in college from that of the student who receives the B.S. degree. But the bachelor of science degree unfortunately does not mean that the student has had a scientific education. It means usually that he has not studied Latin at school and has probably entered college with easier requirements. It is said that to receive the doctor's degree at Heidelberg without honors is a certificate of idiocy. A degree that simply means that a student has not studied Latin as a boy, that his parents did not send him to a fashionable preparatory school, that he perhaps entered college with lower requirements and pursued a shorter course, can scarcely be held in high esteem, and a society of scientific men can not rejoice to see the name of 'science' attached to it.

If we were drawing up a Napoleonic code, probably no one would propose to give different kinds of degrees for different kinds of college work. Where the field was clear Johns Hopkins and Stanford adopted one degree only. Chicago, it is true, took the three conventional degrees, and students of commerce become bachelors of philosophy; let us hope that idealism will be radiated from the packing houses of the city. Cornell, Michigan, Minnesota, Wisconsin, Texas and other universities have abandoned the multiplicity of degrees. In some institutions the professors of classical languages, having lost the substance, cling to the shadow of the bachelor of arts, but unwisely as it seems to me, for their nakedness is uncovered. Thus, according to the last catalogue at hand, there were 2,248 undergraduate students in the University of California, of whom only 284—107 men and 177 women—were in the course leading to the A.B. degree.

I should prefer to see the bachelor's degree conferred with specification of the institution and major subject—bachelor of Harvard in classical languages, bachelor of Michigan in zoology, etc., but this is doubtless out of the question. It seems that for scientific work at college the bachelor of arts degree should be awarded unless the bachelor of science degree can be given a proper standing.

Substantial agreement has been reached in favor of granting the doctorate of philosophy for about three years of graduate work with research, without reference to the direction of work or to the character of the first degree. Harvard, Princeton and one or two other institutions have the degree of doctor of science, but it is seldom conferred. The difference between the D.S. and the Ph.D. at Harvard is that in the case of the former the man may not have studied Latin in the secondary school. Harvard, in order to be consistent, established the M.S. degree three or four years ago, but it was wisely permitted to die in infancy, and the jewel of consistency must be abandoned or secured by doing away with the D.S. The evidence that a man is worthy of the doctorate of philosophy should be given by the publication of the thesis, the appeal being made to experts throughout the work. An oral defense of the thesis before the faculty became antiquated in Germany before we borrowed it. In my opinion the doctorate of philosophy is a professional degree, signifying practically that the recipient is competent to teach and to carry on research in his special subject. All teachers can not be original thinkers, nor should investigation be confined to a few teachers. Physicians,

engineers and others should be educated by research and to research, and there is no reason why they should not receive a degree signifying the accomplishment of original work and the promise of its continuation. The doctorate of medicine has in this country lost any meaning beyond the following of three or four years of routine work. I see no special objection to doctorates of engineering, pathology, etc., but the doctorate of philosophy is quite as suitable. I object to the distinction between liberal and technical studies, as applied to the subject studied, but there is an important difference in the attitude of the student. A student might receive the A.B. or B.S. degree as a sign that he is a well-educated man, and at the same time the professional degree, such as E.E. or C.E., as an indication that he is prepared to practise a certain profession. Then later he could be given the doctorate, if he proved himself competent to advance knowledge.

I am not greatly interested in the question of honorary degrees. I should suppose it might be well to reserve the LL.D. degree for public men, including college presidents and benefactors, and to use the doctorates of science and of letters for the two main lines of productive activity. But, at a matter of practise, the LL.D tends to become a first-class degree and the others second-class degrees. It may seem slightly pedantic for Herbert Spencer to have declined all honorary degrees; but if the members of a society such as this would unite in ignoring them it would be a modest reform.

President Jordan:

May I rise for a few words more? I believe that Stanford University is the only one to grant the degree A.B. at the end of a four years' course of which the major subject is engineering. When the university was organized I wrote its first constitution and put in the degree B.S. for engineering courses. When the faculty met, they decided that the purpose of the engineering courses was not essentially different from the others. They led men toward the profession of engineering. Professor Marx, especially, insisted that the engineering proper should be largely graduate work, and that the spirit of the undergraduate work should not be essentially different from that of other scientific departments. For such reasons the faculty voted to give the degree A.B. for this work. Since then I have not found enough objection to the arrangement to bring the faculty together for a reconsideration. The classical men seem to be satisfied with the thing as it is, and the engineers are looking for the time when engineering shall be a professional subject to be pursued for two years after granting the bachelor's degree. Engineering students are brought more closely to the others by this arrangement, and the more unified the student body is the better. We should have no reason for considering a change unless, as suggested by President Van Hise, all the other institutions should agree to reserve the degree of B.S. for the first four years leading to technical work.

The Chairman:

It seems to me, gentlemen, that these remarks of Dr. Jordan are very suggestive, indeed, as to what is really needed in the entire matter of degrees. The universities of the country which give degrees of course can get together in regard to what they do, and very greatly simplify and very greatly strengthen their attitude in regard to it.

Dr. Cattell has spoken in a very brief way of honorary degrees, and what he said in regard to honorary degrees reminded me of a little experience of my own this last summer. I was botanizing in Mexico, and I ran across a gentleman—a member of the

faculty of one of our large universities—who was prosecuting some field work in another department of science. I had not before met him, but was familiar with his work, and I was rather surprised in the course of conversation to find that he had not the doctor's degree. As he was a young man (men are sometimes compelled by circumstances to take to the harness before they have entirely equipped themselves) and not in what might be called a permanent life position, I was rather surprised that he had not this degree, and when I put a question to him about it, I found that the feeling which has been expressed here in several shapes was very strongly fixed in his mind—that the doctor's degree was hardly worth having, and to him it took this shape: That he was an investigator; he was making his mark; he was getting along; he knew how to do research work; he was already getting recognition as an accomplished investigator; and it was hardly to his interest to make certain sacrifices of money and the disposal of his time that would be necessary in order to get a diploma that would enable him to write Ph.D. after his name. He said: "I have students in my own department who are going to be Ph.D.'s in a short time, but who, I know well enough, will never do a piece of work that I have not thought up and that they do not carry out under my plan. They will get Ph.D.—and of what use is that designation to me?"

This opens one of the very important questions which I hope may come into the discussion this afternoon—that of securing recognition of those professional attainments which distinguish the man who has gone into the field of science from the man who has taken the equipment and bought the armor and weapons but has never gone any farther. And it may be that there is in the future the possibility that the degree which is sometimes conferred for scientific work, doctor of science, which I hold—which I should be sorry to see go, but which is fast becoming entirely obsolete as an earned degree, may be conferred as recognizing the successful investigator in science as distinguished from the gentlemen to whom Professor Cattell would give the degree of LL.D.—almost the one honorary degree that is open to-day for those whose names appear in 'Who's Who.'

The next speaker, who, though not an active college president, has had ample experience as a college president, and at the same time, like all of the speakers, is a distinguished investigator, is Professor Coulter, of the University of Chicago.

Professor Coulter:

I believe that this subject, discussed in a meeting of scientific people or those who have scientific inclinations, is likely to get the sort of handling it would not get anywhere else. We are really somewhat out of sympathy with a great many of the notions that cluster about these degrees, and in our scientific training we seem to have gotten away from any sentiment that belongs to them; and still it remains a fact that most scientific men, in the back of their minds at least, think a great deal about them. Therefore, we are really discussing not what might be called desirable, but that which is a fact. I am free to say that this discussion to me is the consideration of how we shall regulate an evil that is among us, but which we are not yet ready to abandon entirely.

By this preface I wish it understood that I am not favoring degrees, but some rational way of conferring them.

The first point to be made in the discussion, and apparently the chief storm center thus far, is in connection with the bachelor's degree. The old contests to which President Jordan referred in his

opening remarks, in which he and I were concerned, had chiefly to do with the position that in the splitting of courses of study the splitting of the bachelor's degree became an absurdity. The compromise proposition suggested by President Van Hise is exactly the same that was used at that time in reference to what was called the bachelor of sciences. There is the same difficulty in determining what is culture. I have come to wince at the use of that term in discussions concerning education. The attempt to differentiate cultural and non-cultural studies has always ended in confusion. It is not so much a distinction between subjects as between teachers, and this distinction can not be formulated. Any subject or any set of subjects leading to any definite useful end in the hands of a real teacher will result in that stage of advancement, that intellectual status, which the bachelor's degree marks. My claim is that if work in engineering, for example, does not result in such intellectual growth as deserves the bachelor's degree it should be stimulated in that direction. In other words, I can not see how any definite distinctions can be made in the undergraduate period of intellectual development. It is our habit to abolish all distinctions later, and the logic of the situation seems to show that we are not describing kinds of training, but are marking distinct steps in progress.

The only other reason I should have for abandoning the distinctive term 'science' in connection with the bachelor's degree is out of respect for science itself. The amount of science to be obtained in any undergraduate course is so insignificant that to make it distinctive of a degree is somewhat absurd, especially if it be implied that the holders of the degree are in any sense trained in science. No such objection can be urged against such use of the word 'art,' as its significance in this connection has long since become conventional. As investigators we know what undergraduate work means, and it is hardly worth differentiating when it comes to degrees. It is only a certain amount of activity during a certain time; and the bachelor's degree came to be agreed upon as a convenient and well-understood statement of a certain stage in intellectual progress. Therefore, I have long been in favor of what has been called a 'blanket degree.'

I believe that the master's degree, that comes next in the order of succession, is to-day probably the worst abused degree. I have had a notion that it might be made, at least, in scientific circles, a most useful degree, and I have been so using it. I have called it a 'side-track' degree. There are certain well-intentioned students who do graduate work, but who have not the slightest initiative in the way of investigation. They can acquire and they can retail any amount of second hand information, but they can not do original thinking. For them this degree is useful. In other words, I look at it as a teaching degree, given for what might be called teaching ability as distinguished from the ability to investigate. Many a student who is seeking a doctor's degree may be comfortably side-tracked by the master's degree. Thus, if distinctions are to be made, the master's degree might well be retained as a teaching degree, a degree of position also, but not recognized as a distinct scientific degree involving investigative ability.

The doctor's degree has been mentioned by all the speakers and with unanimity of opinion. The only thing needing emphasis is the great importance of granting it carefully, and only to those who are really investigators. Great violence has been done to this degree, and great discredit brought upon it, simply because there has been no way of side-tracking those who do not deserve it. The definite time requirement

gets us into trouble, for it is not easy to make a student who has fulfilled the residence requirement understand that he has not earned his doctor's degree. Such universal action has been taken to prevent the conferring of honorary degrees of this type that I presume scientific bodies need not emphasize it further. But in certain quarters there is still prevalent the correspondence method, by which the student is exempt from residence or scientific work of any type. It is baldly a reading degree, with an essay based upon the reading.

The chairman has suggested a subject that seems to me well worth consideration. We know that there are tremendous differences in the subsequent history of those who have received the doctor's degree, but there has been no method of differentiating them. I do not know how large a percentage of those who actually achieve the doctor's degree are never heard from afterwards. There ought to be a distinction between these still-born doctors and those who continue to live. I can not propose any method, but the chairman has suggested that Sc.D. might be reserved for this purpose and conferred upon those who have continued to investigate and have become real members of the scientific fraternity. Of course, one may say that these men are known already, but we are considering the subject of conferring degrees, not the subject of their abolition.

THE CHAIRMAN:

Possibly an extract from another letter that I have here may come in rather appropriately here. The gentleman, whose name I will not read in connection with the letter, wrote this in response to a letter that I sent him some time ago:

* * * My own opinion is that degrees take their value from the man who receives them, and not *vice versa*. I have a Ph.D. as an assistant who is a valuable helper but can't spell the English language in an ordinary letter, and I know several others who have gained the degree by passing the required examinations and writing a thesis, but of whom science will never be a gainer; so the excessive anxiety of some of our friends as to the bestowal of the degree upon those who, though not college men, are known over the world as contributors to knowledge, seems to me rather silly. However, 'many men, many opinions.'

The plan of the executive committee has been to have the gentlemen who have thus far spoken to you this afternoon speak with the knowledge that they were to be called upon for short addresses; but it is considered very desirable that when possible these annual discussions before the American Society of Naturalists shall partake really of the character of discussions, and I trust that in the next fifteen minutes—because we do not need to adjourn before a quarter after four in order to hear Professor Rutherford's lecture—some of the gentlemen who have not come here prepared to speak may favor us with some remarks. The matter is before the society for discussion.

PRESIDENT JORDAN:

I think that all granting of honorary degrees is subject to great abuses. To use it for spectacular purposes is to destroy its dignity. Governors, senators, donors often merit it, but sometimes they turn it into a farce. The honorary degree of LL.D. is only rarely conferred upon professors, the class of men most worthy of such honors, whereas a college president expects to receive it every time he puts on his gown away from home. It is safer to use degrees only as certificates of fruitful residence.

THE CHAIRMAN:

I think that possibly before allowing other speakers to claim the floor, I may read extracts from another letter, the signature of which I will not read, but it is particularly pertinent to the subject. This gentleman says:

> Your letter makes me wish that I could go to St. Louis, for it is a good work, that of trying to lessen the abuse of honorary degrees. * * * Every learned man, be he scientist or humanitarian, should insist on all occasions that honorary degrees should be given only for academic distinction, and never be given under any circumstances whatever to a politician, a soldier or a business man (as such). * * * has sinned grievously (along with the rest) in this matter, and she should be publicly and severely blamed (along with the rest) for debasing her degrees in this manner. * * *

I trust that others who are here, whether members of the society or not, will now take part in the discussion.

Professor Burrill:

I suppose if this matter could be settled for ourselves here this afternoon it would be very easy. I have a suspicion, however, that whatever we say or do here will not wholly settle the matter outside. It seems to me that the evident tendency of late has been to differentiate degrees along the lines suggested by President Van Hise. It seems to me that already in a great many of the leading institutions the precedent exists, as suggested by President Jordan, that would permit the degree of B.S. to be accorded for a course in applied scientific work; then, we might well enough have the A.B. degree for all of the courses not tending directly towards a professional pursuit. The degree of bachelor of science possibly may not be the proper one for those taking an engineering course, a course in agriculture, etc.; but that seems to be the one that has been pretty generally adopted for that purpose. In the University of Illinois the matter had been discussed some years ago, and lately it has been revived. The degree of bachelor of science was given to students who had taken major work in any science. Now the degree of A.B. is given to all students except those that take courses in engineering, in agriculture and in the new school of commerce. The last has not been settled. I take it, however, that the degree of A.B. will be used there.

There is another thing, however. Whether it is settled thus or in any other manner that seems to be satisfactory, no person taking a course in civil engineering would care for the A.B. degree compared with the degree of C.E. His work is shown pretty well by that degree, the degree of civil engineer, and though they are not so well established, the degrees of mechanical engineer and electrical engineer follow in the same line. Then there is the difficulty about the candidates in architecture. There are several very prominent architectural schools in our country in which students prepare themselves directly for the profession. They confer the degree of B.S. or B.Arch., followed by M.Arch., and finally perhaps by D.Arch.

These professional degrees are given either immediately at the end of the course of four years, or after some further course of study. If I may quote again the institution with which I am most familiar, the degree of bachelor of science is given at the end of four years in the courses of engineering, and then after a further year's work, usually directly following in the line of the specialty—really professional work—the C.E. or M.E. or M.Arch. degree is given. Something like this, I think, must be done; this terminal degree—perhaps we may call it master's degree—must be specialized, whether or not we differentiate the bachelor degree. I am of the opinion, as I say, that the trend of the country, of the institutions, is in favor of making this distinction.

The Chairman:

Are there other speakers? If not, the time for adjournment is rapidly approaching. Before adjourning the meeting I should like to say that as Professor Bur-

rill has pointed out, if we were met together this afternoon to settle this business for ourselves, we probably could so settle it, though we are not likely to settle it for the world at large. But one feature of the Naturalists' discussions has been, as I have watched the discussions, that the members of the society get together to consider in a particularly interested spirit matters which they do not propose to settle, but from the analysis of which they hope that a current of thought may be started which will ultimately result in good. For that reason we have had speakers this afternoon who are representative of geology, zoology, botany and psychology, and who are representative of the country from the Atlantic to the Pacific. I think that we may congratulate ourselves that, although the audience that has listened this afternoon has not been large, the discussion may be brought, perhaps, before a larger audience, and will perhaps start a current of thought in a useful way that will in time contribute to a solution of the problem.

I am going to read one more letter, again without the signature, but a letter from one of the strongest executives of one of the strongest universities in the country:

> I wish very much that I were able to cooperate in the discussion which you propose. Unfortunately, my presence is out of the question, on account of an important previous engagement for the very day which you name; and I am not yet quite ready to send any brief formulation of my views on the degree question. I do not believe that the time is quite ripe for such radical measures as I have in mind; and I would rather that those who think that they can do some good by moderate reforms should have every chance to make their experiments unimpeded by destructive criticism. If those who believe that conservative reform is possible can prove their case I shall be very glad. I should wish * * * to be in a position to cooperate with them on any measures which might give promise of reform. Then if reform measures fail the radicals will have a clear field.

The meeting was then declared adjourned.

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## SCIENTIFIC BOOKS.

*Wilhelm Ostwald:* Von PAUL WALDEN.

IT is well known that in December last the twenty-fifth anniversary of the doctorate of Ostwald was celebrated in Leipzig. On this occasion a 'Jubelband,' being the *forty-sixth* volume of the *Zeitschrift für physikalische Chemie,* and containing original papers from thirty-four of Ostwald's former students, was presented to him. The 'Jubelband' contained a brief sketch of Ostwald's life and work by van't Hoff, but the book under review deals with both in a much fuller manner.

Walden discusses the life of Ostwald in five periods: 'The Youth in Riga, 1853–1871'; 'The Student in Dorpat, 1872–1875'; 'The Teacher in Dorpat, 1875–1881'; 'The Professor in Riga, 1881–1887'; 'The Professor in Leipzig, 1887 up to the present.'

Ostwald does not seem to have been a marked success as a gymnasium student, and not to have taken his work in a really serious manner until he came to Dorpat. His first scientific publication, which appeared in 1875, shows the bent of his mind at the early age of twenty-two. It bore the title, 'On the Chemical Mass Action of Water.' This was soon followed by his 'Volume Chemical Studies,' which are now recognized to be works of real permanent value.

That tremendous activity and power to work, which is possessed by Ostwald to an unusual degree, began to manifest itself during the Riga period. It was during this period that the first edition of the great *Lehrbuch der Allgemeinen Chemie* appeared—the book which led to the organization of the modern school of physical chemistry. It was in Riga also that the *Zeitschrift für physikalische Chemie* was founded. This was to be the official organ of the new physical chemistry which was just being organized, and has probably contributed more to the development of this branch of science than all other publications, in that it brought together in one place

the various lines of work which constituted the new science.

This, however, is all introductory to Ostwald's greatest work. In 1887 he was called to Leipzig to the chair of physical chemistry just vacated by Gustav Wiedemann. To him as director of 'Des zweiten chemischen Laboratoriums' students came from all parts of the world. Through these, and with his own hands, an enormous amount of work was done. These investigations, which were published, when completed, in the *Zeitschrift,* have since been collected and comprise several large volumes. This large amount of work was done under very unfavorable conditions. A small laboratory, poorly lighted and poorly equipped with apparatus and conveniences, may be said to describe fairly the old laboratory of Ostwald in Leipzig.

The cosmopolitan character of the Leipzig laboratory in the nineties, when it was the good fortune of the writer to have studied with Ostwald, is shown by the fact that of the students who were following physical chemistry as their major subject, the following nationalities were represented: Germany, America, Canada, England, Scotland, Belgium and Russia. Indeed, there were more Americans working with Ostwald at that time than there were of any other nationality, including Germans.

This condition of things is all changed now. The fame of Ostwald as investigator and teacher drew such a large number of students that the old quarters became entirely inadeequate. A fine, new Physikalisch-chemisches Institut has been built for Ostwald, and this has now become the home of the 'Leipzig School' of physical chemistry.

The most striking characteristics of Ostwald are his untiring industry, his fertility in ideas and his absolute unselfishness. As an illustration of his power of work, Walden points out that his collected works number already more than 16,000 pages, and in addition to this he has directed probably more than one hundred investigations; has edited the *Zeitschrift,* which is now in its forty-eighth volume, and has founded the *Annalen der Philosophie.*

As illustrating Ostwald's power to work, the writer recalls returning to Leipzig with Ostwald from Berlin in 1894, when van't Hoff delivered his now famous '94' lecture before the Berlin Chemical Society. It was between two and three in the morning when Leipzig was reached. We learned next morning that Ostwald had not retired on returning home, but had spent the remainder of the night in developing some idea that had occurred to him during the journey.

The fertility of Ostwald's mind in new ideas can not have failed to impress any one who had been with him even for a short period, and also the unusual freedom with which suggestions, often of very great importance, were made to any one who had the desire and ability to work them out in the laboratory. And when the work was done the student was told to publish the investigation as if the whole was his own. The result is that a large part of the work done in Ostwald's laboratory does not bear his name, although the original suggestion came from him, and every stage of the investigation was under his daily scrutiny.

All in all, it is difficult to overestimate what Ostwald has already done for chemical science. He is the organizer of the modern school of physical chemistry. But he has gone much farther and shown how the generalizations of the new physical chemistry can be applied to general inorganic chemistry, by both the investigator and the teacher. It is not too much to say that he has inaugurated a new day into the field of general chemistry.

Walden concludes his interesting life of this great man by calling attention to Ostwald's love of art; not as an admirer of finished pictures in a gallery, but as a painter of them. Indeed, one of Ostwald's own pastels is reproduced in Walden's book.

It is interesting to learn not only of the serious work of a leader in natural science, but also how he spends his leisure. In Ostwald we have the love of the scientifically exact, combined with that of the purely beautiful in nature.

Harry C. Jones.

*Lehrbuch der Mineralogie.* Von MAX BAUER, Zweite, Vollig Neubearbeitete Auflage, 1904. Stuttgart, E. Schweizerbartsche Verlagshandlung (E. Nagele). 1904. Pp. xii, Fig. 670.

A second edition has been issued of Dr. Max Bauer's 'Lehrbuch der Mineralogie,' forming one of the most important works in this department of science that has appeared in the German language. It is printed in large clear type upon good paper, with 670 illustrations, and is exceedingly comprehensive and thorough, not only in dealing with the crystallographic, optical and physical features, but in its account of localities and of new species, which are brought absolutely up to date. Dr. Bauer's position as director of the Mineralogical Institute of Marburg, and his long editorship of the *Jahrbuch für Mineralogie und Geologie,* have given him unusual facilities in the preparation of so important a work, and his well known reputation for thoroughness is an assurance as to its being a complete exposition of the subject. It will form an essential addition to every mineralogical library. G. F. K.

## SCIENTIFIC JOURNALS AND ARTICLES.

THE May number of *The Journal of Nervous and Mental Disease* contains the following articles:

'The Central Localization of the Sensory Tract,' by H. H. Hoppe. It contains a full summary of recent anatomical and pathological work on the central localization of sensory functions. 'Two Tumors of the Brain' are reported on by Dr. T. M. McKennan, and Dr. Smith Ely Jelliffe presents a statistical summary of the work of the neurological clinic of Dr. M. Allen Starr for 1903. He shows that in 16 years 31,600 patients have been treated for nervous disease and that about 4 per cent. of all diseases are of the nervous system. 'Two Cases of Meningeal Tumor' are described by Dr. A. C. Brush. These were treated by ligature of the meningeal vessels. 'The Influence of Fever in the Pain of Locomotor Ataxia' is discussed by Dr. C. W. Burr. This number also contains accounts of the meetings of the Philadelphia and New York Neurological Societies, and its regular series of abstracts from the leading neurological journals, *Revue Neurologique, Neurologisches Centralblatt, Deutsche Zeitschrift für Nervenheilkunde, Monatschrift für Psychiatrie und Neurologie* and *Jahrbücher für Psychiatrie und Neurologie* being noted in this number.

CONTENTS of the *Journal of Comparative Neurology and Psychology* for April:

O. P. JENKINS and A. J. CARLSON: 'Physiological Evidence of the Fluidity of the Conducting Substance in the Pedal Nerves of the Slug, *Ariolimax columbianus*.'

C. W. PRENTISS: 'The Nervous Structures in the Palate of the Frog: The Peripheral Networks and the Nature of their Cells and Fibers.'

C. L. HERRICK: 'The Beginnings of Social Reaction in Man and Lower Animals.'

ROBERT M. YERKES: 'Inhibition and Reinforcement of Reaction in the Frog, *Rana clamitans*.'

RAYMOND PEARL: 'On the Behavior and Reactions of *Limulus* in Early Stages of its Development.'

Editorial.

G. E. COGHILL: A Critical Digest of Recent Studies on the Finer Structures of the Nerve Cell.

Literary Notices.

## SOCIETIES AND ACADEMIES.

### THE BOTANICAL SOCIETY OF WASHINGTON.

THE April meeting of the society was held Saturday evening, April 23, at the Portner Hotel. Mr. David G. Fairchild acted as chairman of the program. After the regular review of literature Dr. George T. Moore, of the Department of Agriculture, spoke on the subject, 'A Method for the Destruction of Algæ and Pathogenic Bacteria in Water Supplies.' The speaker mentioned briefly the history of some of the serious difficulties that have been experienced by the water departments of many cities as a result of contamination of the reservoirs by algæ of one sort or another. He said that he had received numerous complaints from each state of the union, showing that the trouble is general. Its seriousness in many cases is shown by the fact that controlling engineers have in some cases recommended that supplies representing an investment of several million dollars be

abandoned, simply on account of the continued trouble from algæ. The direct result of the presence of algæ in serious cases is that the water acquires a very disagreeable odor and taste which may resemble that of decaying wood or has what is described as a 'fishy' smell and taste. Often this odor and this taste are not due to the decomposition of the plants but are caused by small drops of oil secreted by certain of the algæ.

Up to the present time no practicable remedy has been found for this trouble which is capable of general application. Double filtration, covering the reservoir, the removal of all organic matter and similar expedients have all been tried, and in some cases proved nearly or quite efficient, but such means are usually too expensive or for some other reason are impracticable. It has been shown by experiment, however, that it is quite feasible to treat infected reservoirs with copper sulphate in such quantities as to give a solution varying from one part in a million down to one part in 500 million. The former strength is not considered harmful even as a constant beverage, and the latter dilution appears to be effective in disposing of most algæ under ordinary conditions. In water containing any appreciable amount of lime or organic matter, the copper is soon precipitated out, so that the danger of harmful overdosing is still further prevented.

The speaker deprecated the extravagant statements that have recently been made in the daily papers regarding the efficacy of this copper treatment in ridding water supplies of certain pathogenic bacteria, such as the germs of typhoid and cholera. In his opinion the present indications are that where no other remedies can be applied to prevent or remove bacterial infection this may be accomplished by treatment with copper. It is in no way designed to replace slow sand or other effective filtration methods now in use, but it is believed may be of some service where such systems are not installed.

Mr. L. L. Harter, of the Department of Agriculture, then spoke on the subject, 'Varietal Differences in Resistance to Toxic Salts.' The speaker outlined some experiments that he has recently undertaken with a view of determining whether or not varieties of the same species differ in their resistance to toxic salt solution. He has conducted the work with wheat varieties obtained from various sources and which show great diversity of climatic and soil conditions.

He found that it required a solution of sodium carbonate three times as concentrated to kill a Kansas or Russian variety as it did one from Michigan. The limits in sodium chloride varied from .045 to .055 of a normal solution, and of sodium bicarbonate from .025 to .03. He further showed that the Michigan and Russian varieties are two and one half and two times respectively more resistant in magnesium chloride than one obtained from Turkestan. Almost as great a variation was obtained with the Michigan and Kansas varieties over the one from Turkestan, requiring in both cases twice the concentration of magnesium sulphate to kill the root tips.

Carl S. Scofield,
*Recording Secretary.*

THE TORREY BOTANICAL CLUB.

The meeting of Tuesday, March 8, 1904, was held at the College of Pharmacy, with Vice-president Rusby in the chair; there were seventeen persons present. The minutes of the preceding meeting were read and approved.

The first paper on the scientific program was by Professor Francis E. Lloyd on 'Recent Investigations on the Pollen-tube,' and was an interesting exposition of the parallel results of Longo's investigations on the behavior of the pollen-tube in Cucurbitaceæ and Professor Lloyd's work on Rubiaceæ.

Longo finds that in *Cucurbita Pepo* L., the ovary is provided with a special conductive tissue reaching to the neck of the flask-shaped nucellus by means of which the pollen-tube follows a completely intercellular course from stigma to embryo-sac. In other species of *Cucurbita* and in *Citrullus vulgaris* the neck of the nucellus is not long enough to reach to the conductive tissue, so that for a short distance the tube must move through a cavity. On reaching the neck of the nucellus, the pollen-tube forms a bulla that produces lateral outgrowths which Longo believes are for the

purpose of reaching out after food materials, as their size seems to depend on the amount of starch present. This view is rendered somewhat questionable by the phenomena observed by Wylie in *Elodea*, where pollen-tubes may produce similar 'cystoids' in the free space of the locule, but never produce them in the tissues where food substances must be more abundant.

Longo supports his conclusion that the intercellular course of the pollen-tube is followed not because of inability to grow in open space, by showing that pollen-tubes may be produced in moist air from such normally endotropic forms as *Humulus Lupulus* L., *Picea excelsa*, etc. He interprets chalazogamy as a physiological fact having bearing on phylogeny. In plants having endotropic pollen-tubes, he considers the direction of their growth to be determined chemotactically.

The main points in Professor Lloyd's independent conclusions from work on Rubiaceæ are: (1) The form of cells in the conductive tissue does not determine the course of the pollen-tube, for in *Richardsonia* and *Diodia teres* the cells are elongated at right angles to the path of the tube. He believes the chemotactic stimulus which determines the direction to be differentially distributed from the egg cell. (2) The ectotropic or endotropic behavior of the pollen-tube is a physiological character.

The second paper of the evening, by Mr. Edward W. Berry, was entitled 'Some Monotypic Genera of the Eastern United States and their Ancestors.' The phylogeny of *Liriodendron* was briefly sketched from its first appearance as a narrow simple-leaved form in the mid-Cretaceous of the Atlantic coastal plain, its spread to Europe and Asia, its development into large lobate leaved forms, and its final extinction except for the existing species of eastern North America and a waning variety in eastern Asia. Drawings of all the fossil species were shown, and numerous blue-prints of the leaves of the existing species, showing their parallelism and range of variation.

*Sassafras* was the second genus considered. It was pointed out that while the described fossil species were numerous, many of them are not allied to *Sassafras*. The species which were considered as positively identified were discussed, as well as the peculiar characters of the leaves of the existing species, both ancient and modern forms being abundantly illustrated.

The third genus discussed was *Comptonia*. Its former range and development were described and drawings of a number of the species were shown.

All three genera were considered to have taken their origin from simple-leaved ancestors which flourished during the closing days of the lower cretaceous, and to have originated in America, becoming dominant and widespread in pre-glacial times, finally becoming restricted to their present habitats chiefly through the agency of the glacial conditions of the Pleistocene period.

The paper was discussed by Professors Rusby, Underwood and Lloyd and Dr. Howe.

Tracy E. Hazen,
*Secretary pro tem.*

THE NEW YORK ACADEMY OF SCIENCES.

SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

The regular meeting of the section was held on April 4, at the American Museum of Natural History. The program consisted of three papers, abstracts of which are as follows:

*The Variation of Latitude at New York City; Part 2, Variation of Latitude and Constant of Aberration:* J. K. Rees, Harold Jacoby and Herman S. Davis.

The results of seven years' continuous observations for a study of latitude variation and the aberration of light are contained in the present paper, which will appear as the second and last part of Vol. 1, in the academy's series of *Memoirs*. To that publication the reader is referred for complete details and results; it is not possible here to do more than mention very briefly the plan of the work, and to state the fact of its completion.

The simultaneous and continuous observation of the same stars at stations situated on a single parallel of latitude, but separated widely in longitude, has long been recognized as the best method of attacking the problem

under consideration; the first actual practical application of the method is the one treated in the present paper. The other participating observatory is the one at Capodimonte, near Naples, where simultaneous observations were made by Professor Fergola and his associates.

The New York and Naples work was continued until a similar, but a more elaborate, plan was put in operation by the International Geodetic Association, which includes all civilized governments. This plan involved the establishment of four suitable special latitude stations, and rendered further work at New York and Naples unnecessary.

*Energy Liberated by Thorium:* George B. Pegram and Harold W. Webb.

The method used in this investigation of the energy liberated by thorium due to its radioactivity was to measure the difference between the temperature of three kilograms of thorium oxide, enclosed in a Dewar bulb, and that of a surrounding ice-bath, by means of a set of iron-constantin thermo-electric couples. Uniformity of temperature in the bath was secured by means of a rotating stirrer and careful heat insulation. The thorium oxide was cooled, so that its initial temperature was below that of the surrounding bath. Readings were taken at frequent intervals, and after several days the difference of temperature became constant, with the oxide .04° warmer than the bath. Several such series of observations were made. From the rate of change of temperature and from an approximate calculation of the heat capacity of bulb and oxide, a tentative value of the heat liberated was found; $8 \times 10^{-5}$ gram-calories per gram of thorium oxide per hour (.93 ergs per gram per second), or $9 \times 10^{-5}$ gram-calories per gram of pure thorium per hour. Further investigation is being made to determine these values more accurately.

*Note on a Tribophosphoroscope, and the Duration and Spectrum of Tribophosphorescent Light:* Wallace Goold Levison.

Discs of thick pasteboard about 15 cm. in diameter are evenly sanded on one or both sides on a coating of liquid glue with the materials to be examined in powder, narrow bands being sufficient and only small quantities of the materials required.

The disc selected is then rotated at a known and usually moderate speed (twelve revolutions per second, for example) by any convenient mechanism, such as an ordinary rotator used for illustrating the recomposition of light.

A point or brush of wire or other material, or a piece of the same material with which the disc is coated, being pressed against the sanded surface, produces a trail of light which extends from the point of contact in an arc more or less around the disc; varying in color with different materials and in length with the speed, and is maintained for some time unless the material is rubbed off by extreme friction. A grindstone or corundum wheel may often be used to advantage with hard substances as a substitute for the disc, since a specimen held against it soon coats it with a trace of the material which shows its luminous trail beautifully.

By means of the device described the intensity of the light may be determined with a photometer, its duration from the length of the trail, and its spectrum delineated with a spectroscope.

The following approximate, tentative results of the examination of a few minerals are given to illustrate its applicability.

1. Sphalerite (1) from Utah. Light yellow concretions in gray massive sphalerite. Visible trails are produced of respectively increasing brilliancy and length with the tip of the finger; a wooden match; the finger nail; a brass wire brush; and a steel wire brush, or point; of a yellow orange color, visible, with the latter, at a distance of several yards and extending about one quarter around the disc at the above speed. Hence, the duration is about 0.02 s. The spectrum is short, extending from about the line $C$ to the line $E$ and embracing some red, orange, yellow, yellow-green and green. (2) From another locality very similar to the above in character, and afforded like results. (3) Of several dark colored sphalerites some showed a little light

at the point of contact of the brush, but no trail.

2. Quartz. (Sandpaper disc or grindstone.) No light from brushes (except incandescent sparks from hard steel). A piece of quartz, however, gives a bright yellow light, and if of rock crystal is luminous within by internal reflection. Very short trail and duration.

3. Corundum. (Emery paper disc or corundum wheel.) No light from brushes (except as above). A piece of ruby or ruby corundum against the corundum wheel or a grindstone evokes a brilliant crimson light and short trail and is luminous within by internal reflection. Duration about 0.005 s.; a piece of emery against a corundum wheel gives a like trail but is not itself luminous.

4. Pectolite, Woodcliff, N. J. Wire brush. Light greenish-blue trail only medium bright but extending completely around the disc. Duration over 0.08 s.

5. Limestone, Hellfire Rock, Utah. Feeble greenish-blue but similarly long trail. Duration over 0.08 s.

6. Willemite. (1) Hard yellow-green gem material, Franklin, N. J. Short greenish-yellow trail. Duration very short. (2) Opaque, massive green variety. Feeble short green trail. Duration about 0.02 s. Best obtained with a spectrum pressed against a corundum wheel or grindstone. Various specimens give somewhat different effects. (3) Pink or brown variety. Longer and brighter green trail. Duration about 0.03 s.

7. Chlorophane. (1) Violet from Trumbull, Conn. Bright green and very long trail; best obtained by friction of a specimen against a grindstone or corundum wheel or a disc coated with the same material. Duration over 0.40 s. Spectrum broad band in the yellow-green and green. (2) Green from Amelia Co. Courthouse, Va. Trail similar but brighter; spectrum similar. (3) Red from Haddan Neck, Conn. Trail similar.

In the discussion of the paper that followed Dr. George F. Kunz stated that Professor Baskerville and himself had under examination a zinc-blende from Utah, the natural mineral varying in color from yellow to fawn and to pale brown. This was the most intense tribo-luminescent substance that they had yet investigated. Two bits one fourth the size of a pea, if pressed together lightly with the fingers, caused a brilliant yellew green light to glow as long as the pressure lasted; and it also possessed the property of becoming radio-responsive to the beta and gamma rays of radium; that it was the first natural zinc-blende they had examined that showed this remarkable property.

Mr. W. J. Hammer showed a sample of artificial blende made by Mr. W. S. Andrews, of Schenectady, N. Y., which gave very strong tribo-luminescence.

C. C. TROWBRIDGE,
*Secretary.*

THE ACADEMY OF SCIENCE AND ART OF PITTSBURG. SECTION OF BIOLOGY.

THE regular monthly meeting of the section was held on February 2 in the lecture hall of the Carnegie Institute. Three topics were presented. The first paper was offered by Mr. W. E. Clyde Todd, on 'The Birds of Erie and Presque Isle, Erie County, Pa.' This paper is based on his personal observations during the season of 1900, supplemented by extensive field notes made by local observers, and published records.

The locality in question is considered by the author as the most favorable in the entire state for the study of water-birds. Two hundred and thirty-seven species are recorded. A full account is given of the physical features and climatic conditions of the lake shore plain, and after a careful study of the avifauna of the region Mr. Todd reaches the conclusion that it should be included in the Alleghenian fauna.

Dr. A. E. Ortmann followed with a paper on 'The Cosmopolitan Character of the Deep-Sea Fauna,' stating that a small collection of deep-sea schizopods from the Hawaiian Islands, recently received at the Carnegie Museum, has furnished a few new cases which show very wide horizontal distribution. Species found hitherto only in the Atlantic Ocean are recorded for the first time from the Pacific, a circumstance which strongly suggests their

cosmopolitan distribution. This fact is not, however, a new discovery, as similar cases have been observed before, but it is considered worth while to carefully record all these cases, since it has been doubted whether a world-wide distribution is a prominent characteristic of the deep-sea fauna.

Although it is not contended that there are not cases of a more restricted distribution among abysmal animals, yet we must recognize cosmopolitan distribution as a remarkable feature of the deep-sea fauna, inasmuch as we have a very good explanation of this condition of affairs, in the fact that climatic differences are not present in the deep sea, as its temperature is uniformly cold.

Frederic S. Webster closed the meeting with his topic 'The Smallest Carnivore,' exhibiting four of the seven known specimens of this rare and diminutive weasel, *Putorius allegheniensis*. One of the mounted specimens was taken but a few days before the meeting of the section, and is very interesting, as it proved to be an adult male, and the first one of this sex secured. It is beautifully dressed in a dense winter coat of clear unstained white, excepting a few rather pale brownish markings on the crown and occipital region, and a very narrow dorsal line, about the length of the sacrum, and another small spot on the heel of the right leg. A few dark brownish hairs tip the short delicate tail.

Three important features were pointed out, *i. e.*, that the well-known disproportion in size existing between the sexes of other species of weasels is not a marked characteristic of this little-known species, nor does the indistinct brown of the tail seem to indicate that this member is furnished with the usual black of the other species.

Another interesting feature is noticeable in the dentition, and as this peculiarity is present in three of the specimens (the fourth specimen has the incisors of the mandible injured) we are inclined to believe that it is a constant feature of this species.

In all the skulls of *Putorius noveboracensis* in the collections of the Carnegie Museum the mandibular incisors are placed more or less in a continuous line, and can be readily counted when the jaws are closed, but in *Putorius allegheniensis* the second incisors are posterior, being placed *quite* back of the first, and third, and are consequently neatly hidden away behind these teeth when the jaws are closed, giving the impression that there are but four incisors present in the mandible instead of six.

A second specimen, also mounted, is in winter coat, but considerable brown is spread here and there over the dorsal region. But little brown or black tips the tail.

A third specimen was that of a mimmied animal in summer pelage. The throat and chest are irregularly marked with white; the abdomen has the same uniform brown of the back.

The fourth specimen (a skin) had considerable white on the under parts; but is not evenly distributed.

It would not be surprising if, when a specimen in full summer pelage is obtained, we should find that this species differs from the other weasels in wearing throughout a uniform coat of brown in summer.

Six of the seven specimens taken have been found in Pennsylvania. The male specimen was caught at Pravo, Jefferson County, Ohio, in a box trap, by a country lad, and he, thinking it a common 'varmint,' promptly despatched it by placing the trap in a trout stream.

FREDERIC S. WEBSTER,
*Secretary-Treasurer.*

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

THE sixth regular meeting of the Society for Experimental Biology and Medicine was held on the evening of April 20, in the bacteriological laboratory of the department of pathology of Columbia University, at the College of Physicians and Surgeons. Dr. S. J. Meltzer presided.

*Members Present.*—Burton-Opitz, Calkins, Gies, Hiss, Hunt, Jackson, Lee, Levene, Lusk, Meltzer, Murlin, Norris, Park, Richards, Wadsworth, Wallace, Wilson, Yatsu.

*Members Elected.*—J. J. Abel, E. G. Conklin, A. R. Cushny, C. B. Davenport, W. H.

Howell, L. B. Mendel, T. H. Morgan, F. G. Novy, W. T. Porter, L. B. Stookey, W. H. Welch.

*Constitutional Amendment.*—The following amendment was added to the constitution by unanimous vote: "Each non-resident member shall be required to present in person, at least once every two years, a communication containing the results of an *experimental* investigation, or to send to the president, within that time, such a communication for presentation at a regular meeting of the society."

*Eligibility to Membership.*—Many inquiries regarding admission to membership in the society have recently been addressed to the secretary. It seems desirable to state publicly that only *active investigators* in biology or medicine are eligible to membership. The constitution of the society provides for *automatic forfeiture of membership* by any member who may cease to be an 'active investigator, *by experimental methods,* in biology or medicine.' Visitors are welcomed to the meetings.

Abstracts of reports of original investigations:*

*On the Secretion of Human Bile:* P. A. Levene, W. G. Melvin and B. Michailowski.

The bile was obtained from a patient with a biliary fistula. The patient had been operated upon for gall stones, and was in comparatively good health at the time of the experiment.

| Diet and Dosage. | Volume—24 hrs., c.c. | Total Solids, %. | Organic Matter, %. | Ash %. |
|---|---|---|---|---|
| Mixed diet | 780 | 1.57 | 0.76 | 0.82 |
| Animal diet | 785 | 1.68 | 0.60 | 1.08 |
| Milk diet | 845 | 1.61 | 0.56 | 1.05 |
| Vegetable diet | 835 | 1.64 | 0.80 | 0.84 |
| Sodium carbonate | 461 | 1.62 | 0.71 | 0.92 |
| Hydrochloric acid | 461 | 1.53 | 1.08 | 0.45 |
| Calcium chloride | 687 | 1.63 | 0.56 | 1.08 |
| Sodium salicylate | 642 | 1.40 | 0.42 | 0.98 |
| Methylene blue | 864 | 1.58 | 0.54 | 1.04 |

Attention was directed to (1) the influence of diet on the quantity of bile secreted per twenty-four hours, (2) the permeability of the biliary ducts for certain substances like methylene blue and sodium salicylate, (3) the influence of these substances and of some salts and acids on the secretion, and (4) on the nature of the so-called 'bile mucin.'

The quantities of bile secreted under different conditions, together with other data, are briefly summarized above.

For methylene blue and sodium salicylate the bile ducts proved less permeable than the kidneys. There was observed a marked increase in secretion after subcutaneous injections of methylene blue. The 'mucin' was found to be a phosphorized proteid, but no purin bases could be detected in its molecule.

*Experiments with Certain Nitriles and their Antidotes:* Reid Hunt.

Experiments (carried out in the laboratory of Professor Ehrlich) on the toxicity of a number of nitriles, and the antidotal action of certain sulphur compounds towards them, were described. Most of the nitriles studied are poisonous in virtue of the HCN which is split off in the body; in the case of some of the nitriles of the aromatic series and of certain amino nitriles, the molecules themselves seem to be poisonous. Although each of nearly all of the compounds studied is capable of splitting off one molecule of HCN, it was found that the toxicity of the various compounds differed greatly. The toxicity depends in general upon the ease with which the HCN is split off; in some cases this seems to bear a relation to the ease with which the residue united to the CN group is oxidized in the body. Benzonitrile, containing the group $C_6H_5$, which is oxidized with difficulty in the body, is scarcely more poisonous than phenol. Acetonitrile, also containing a group, $CH_3$, which is oxidized with difficulty, is also but slightly toxic. Propionitrile and formaldehydecyanhydrin, which contain easily oxidizable groups, $C_2H_5$ and $CH_2OH$, are very poisonous.

The toxicity of the molecules of a few nitriles is greater than that of HCN itself, although the latter was the only toxic agent involved. Thus, the molecule of chloralcyanhydrin, $CCl_3CH(OH)CN$, is nearly twice as toxic as that of HCN. The probable explanation of this is that the chloral residue with

* The authors of the reports have furnished the abstracts. The secretary has made only a few abbreviations and minor alterations in them.

which the CN is in combination causes this compound to be distributed especially to the central nervous system; the HCN is thus split off in greater concentration in these important organs than is the case after the administration of a compound which is distributed more uniformly to important and unimportant organs. Through the application of this principle it may be possible to modify the distribution in the body of a remedial agent, so that the active principle may be present in especially great concentration in the organs which it is desired to affect. It was suggested that the powerful action of nitroglycerine upon the blood vessels may be explained on a similar hypothesis. The view of Hay, that the dilatation of the blood vessels caused by nitroglycerine is due to the formation in the organism of nitrites from this body has been generally accepted, although the objection has been made that it requires two hundred times more sodium nitrite than nitroglycerine to produce a given effect. This criticism may be met by the hypothesis that the glycerine residue of the nitroglycerine causes this compound to be distributed especially to the arterial walls, so that the nitrite will be formed in greatest concentration at the point where it exerts its action.

The work of Heymans and Masoin on the antagonistic action of sodium thiosulphate towards certain nitriles was extended to many new cyanogen compounds. In addition to the thiosulphate, several other compounds, containing a sulphur atom which is easily split off, were tested (the sulphur unites in the body to form a little poisonous sulphocyanate). The most efficient of these new sulphur compounds were thialdin, carbothialdin and potassium xanthogenate. Great differences in the extent of the antidotal action of these bodies towards the various nitriles were noted. Thus, thialdin protected against nitriles towards which potassium xanthogenate was without action; towards other nitriles potassium xanthogenate was the more efficacious. Many of these differences can be easily explained on the hypothesis that the various nitriles and sulphur compounds are differently distributed in the body. Unless both the sulphur compound and the nitrile reach the same cells, and unless the conditions in these cells are favorable for the formation of the sulphocyanate, no neutralization will take place.

Especially interesting are the experiments on the antidotal action of alcohol towards certain nitriles. It was found that small doses of alcohol protected an animal against three to five times the fatal dose of acetonitrile and formaldehydecyanhydrin, and that after otherwise fatal doses of these substances, the animal recovered if small doses of alcohol were given. It was suggested that the explanation for this action may be that, because it is easily oxidized, alcohol consumed the oxygen usually available for the oxidation of the $CH_3$ and $CH_2OH$ groups of these compounds, and for the consequent liberation of the HCN. Support for this hypothesis was found in the fact that dextrose (another easily oxidizable substance) also protects against acetonitrile.

This seems to be the first case in which alcohol has been clearly shown to have an antidotal action toward a poison. It was suggested that alcohol may have an analogous action in certain pathological conditions in which physicians have long claimed a beneficial result from its use. Toward HCN itself and several other nitriles, alcohol has no antidotal action; in fact, in some cases the toxicity of the nitrile was increased by it.

*Toxicity of Certain Quinine Derivatives:* Reid Hunt.

In one of the side chains of the quinine molecule there is, according to the commonly accepted view, a vinyl group, $-CH=CH_2$. As the toxicity of many compounds (*e. g.*, neurine and allyl alcohol) is chiefly due to the presence of such a group, experiments were made (in Professor Ehrlich's laboratory) to determine whether this is the case with quinine. A number of derivatives in which the vinyl union was broken by the addition of H (hydroquinine), or of O or OH (oxyhydroquinine), or of H and Cl (hydrochlorquinine), were tested as to their toxicity upon various mammals and certain infusoria. The experiments showed that the presence of the vinyl group in quinine is without special significance as far as toxicity is concerned, the first two of

the new compounds being about as poisonous as quinine itself. The results of the experiments with hydrochlorquinine are of special interest; these showed that the addition of H and Cl decreases the toxicity for mammals while increasing it for infusoria. Thus the amount of hydrochlorquinine required to kill mice was two and a half times as much as that of quinine, while the former substance is distinctly more poisonous to certain infusoria than the latter. It is possible that hydrochlorquinine (or similar compounds) will be found to be more effective than quinine, in the treatment of malaria, and further work along these lines may result in the discovery of quinine derivatives which will be of value in certain diseases, caused by protozoa, in which quinine is of little value. Further experiments are in progress.

*Report on the Metabolism of a Case of Diabetes Mellitus:* A. R. MANDEL and GRAHAM LUSK.

The case was a young man whose urine contained no albumin, little ammonia, only a small amount of acetone and no $\beta$-oxybutyric acid. All these symptoms are said to justify a favorable prognosis. The patient was put on three different diets for three successive periods: Diet I.—Rich cream, oatmeal, meat, eggs, butter; Diet II.—Same as I., with 100 grams of levulose; Diet III.—Rich cream, meat and eggs. The oatmeal was used on account of the favorable results obtained by Von Noorden.

Diet III. was practically a meat-fat diet. Upon this diet the polyuria decreased and the sugar fell from 8 to 4 per cent., both of which phenomena would be favorably interpreted by the clinician. But on calculating the ratio between sugar and nitrogen in the urine (after deducting the sugar fed in the cream) the relation between the two was found to be 3.65 grams of dextrose to 1 gram of nitrogen, as follows:

| 1904. | Dextrose, grams. | Nitrogen, grams. | D:N. |
|---|---|---|---|
| March 2...... | 82.7 | 23.0 | 3.60:1 |
| 3...... | 87.1 | 23.8 | 3.65:1 |
| 4...... | 100.7 | 27.5 | 3.66:1 |

It will be noticed that the sugar and nitrogen rise and fall together. The amount of fat fed varied, but did not affect the ratio. The sugar production is therefore parallel to the proteid metabolism. Since 1 gram of urinary nitrogen represents the destruction of 6.25 grams of proteid, we can calculate the sugar production from proteid. This D:N ratio is the same as that obtained in our laboratory in phlorhizinized dogs. It has also been obtained by others in the human subject, but has been falsely interpreted as indicating the production of sugar from fat. It represents the maximum output of sugar from proteid and a complete intolerance for carbohydrate. It is probably the most grievous prognostic sign in diabetes.

A calculation shows that the carbohydrates in the oatmeal and levulose were nearly quantitatively eliminated in the urine when the patient was under the influence of Diets I. and II.

The patient rapidly lost in weight and died in coma five weeks after the completion of the above investigation.

*Antihæmolytic Properties of the Serum of Nephrectomized Rabbits:* S. J. MELTZER and WILLIAM SALANT.

In studying the properties of the blood of nephrectomized rabbits it was found that bullock's serum, which is distinctly hæmolytic, for normal rabbit's blood, was less so for the red cells of nephrectomized rabbits. It was found, further, that the serum of nephrectomized rabbits contains a distinct antihæmolytic element which is destroyed by heating for an hour at 58° C. On the other hand, the 'washed' red cells of nephrectomized rabbit's blood are at least no more resistant to the hæmolytic influence of bullock's serum than the red cells of normal rabbit's blood.

*On the Influence of Suprarenal Extract upon Absorption and Elimination, with Demonstration:* S. J. MELTZER and JOHN AUER.

In a series of experiments it was found that a previous intravenous injection of adrenalin will make a rabbit resistant to a surely fatal dose of strychnine. (Such an experiment was demonstrated to the society.) In experiments with subcutaneous injections of fluorescein it was also found that in the animal which had previously received injections of adrenalin the

greenish yellow color of the conjunctiva, mucous membranes and skin appeared much later than in the control animal. Both results might be due to delayed absorption or delayed transudation, or to both. In further studies with subcutaneous injections of fluorescein it was found that the color entered the blood later, and in diminished quantity, in the adrenalin animal than in the control. Among other observations, it was noted that the kidneys of the control animal were more intensely colored than those of the adrenalin animal. The same difference was found when equal quantities of the stain were injected directly into the blood stream. The lesser coloration of the kidney is therefore due to the diminished elimination by the kidneys in the adrenalin-animal. Other related problems are still under consideration. But the reported series of experiments already justify the conclusions that suprarenal extract delays absorption as well as elimination.

The starting point for the investigation was the hypothesis, stated by Dr. Meltzer in another publication, that since capillary endothelia possess irritability and contractility, their pores are surrounded by rings of contractile protoplasm which act like sphincters upon them, thus increasing and decreasing the permeability of the endothelia. The explanation for the observed facts is now offered that suprarenal extract, which causes contraction of the smooth muscle fibers of the arterioles, causes, also, an increase of the contractility of the endothelia, diminishing thereby their permeability and thus reducing their powers of absorption and elimination.

*Mendel's Law.* E. B. Wilson.

A review of the more important facts in Mendel's observations, together with a statement of some of the deductions to be drawn from them.

William J. Gies,
*Secretary.*

SCIENCE CLUB, UNIVERSITY OF WISCONSIN.

The seventh meeting of the club for the year 1903–04 was held in the physical lecture room of Science Hall, April 26.

The first paper, by N. M. Fenneman, on 'The Arapahoe Glacier in Colorado' was a description of some recent explorations by the author and investigation of the character of the Arapahoe Glacier. This glacier lies about twenty miles west of Boulder, Colorado, and is about a half mile long and about a half mile wide. It has been only recently that the glacier has been studied scientifically. The glacier follows the type of the North American glaciers.

The second paper, by W. D. Frost, on 'The Antagonism of Certain Saprophytic Bacteria against the Typhoid Bacillus' developed the facts that four very common bacteria produce substances that kill the typhoid germ; that these substances are heat stable but that their efficiency varies directly as the temperature; and that they are alkaline and are neutralized by acids. Mr. Frost's experiments have shown that at the temperature of the ice-chest these substances do not kill the typhoid germs and hence is explained the prevalence of the most severe epidemics of typhoid in winter.

After the foregoing papers were read and discussed the club proceeded to elect the following officers for 1904–5:

*President*—H. L. Russell.
*Vice-President*—A. Trowbridge.
*Secretary-Treasurer*—F. W. Woll.

Victor Lenher,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### SHALL WE HAVE TWO GRADES OF COLLEGE PHYSICS?

The writer has examined about twenty catalogues of institutions where technical courses in engineering exist side by side with courses which may be termed general or cultural. Of these only five made any distinction in the manner in which the subject of physics was presented to students in their various departments. Doubtless a more extended investigation of the subject would reveal others, but it is probable that the ratio would not be greatly changed.

I wish in this note to raise the question whether it is not wise to give two courses in general physics in such institutions as have been referred to, the one being adapted to en-

gineering students, and the other to classical, chemical and literary students. Personally I believe it is highly desirable to make this distinction.

The problem of the inequality of student interest and capacity is one that confronts college teachers of physics in an unusual degree. It does not always (and, perhaps, not usually) follow that the poorest students in physics are the poorest in other subjects; it is simply that the charms of physics reveal themselves only to those who are willing to work hard and long over its perplexities. A course in history or civics may appeal to a student who expects to go into business when he leaves college, but optical interference and magnetic hysteresis are likely to appeal only to the specialist.

As a rule these two classes are clearly defined. Students who are expecting to use physics as a foundation for technical branches will master its difficulties as a matter of course; while the other class think themselves aggrieved that they should be burdened with mathematical theories and problems.

There results a very unfortunate state of affairs when these classes of students are reciting in the same division. The question, therefore, arises, Is there not some remedy for the difficulty? And the only possible solution becomes an easy solution if we are ready to answer affirmatively the question propounded in the heading of this article.

Leaving out of consideration the question of ease or difficulty in teaching, does it not seem fitting that physics should be presented to a student who is looking towards civil or electrical engineering, somewhat differently than to one who is preparing for law, theology or business? To be more specific, it seems to the writer that the mathematical treatment of physical subjects is undesirable in cases where the student is not looking forward to further work along this line. It is unfortunate that a subject so delightful under certain conditions should be made the bugbear of the course by insistence upon rigid mathematical applications. For example, Hastings and Beach's textbook, to which I can not pay a higher compliment than to say that I use it each year with about eighty engineering students, is, in my opinion, absolutely unadapted to students in classical, literary or chemical courses.

What is the purpose of the training in physics which these latter students receive? In the first place it develops their reasoning faculties in a very high degree; secondly, it makes (or ought to make) them familiar with the historical development of the various physical theories which are commonly accepted at the present time; thirdly, it gives them an insight into the laws and processes of nature. If these points are well taken, it may be admitted that for the development of logical methods and processes nothing can surpass the applications of mathematics to physics; but such a large amount of similar training must of necessity come from the various mathematical courses usually pursued that the first need not be insisted upon. It is rather the second and third statements of the advantages of physics for general students that appeal to us. And these are very distinct from the purposes of a course for technical students. It would without doubt be a poor technical course which entirely neglected the historical development or other general features of the subject, but, on the whole, the purposes of general and technical courses are diverse. One who is looking forward to the law as a profession ought to know the conditions under which the law of gravitation was discovered, and something of the development of the doctrine of the conservation of energy. But there is no occasion for his mastering, or better, life is too short for him to stop to master, the mathematical development of simple harmonic motion or the kinetic theory of gases.

The fact that so many institutions prescribe the same courses in physics for students in all departments would indicate that there must be good reasons for so doing. This note is written by one who pursues the opposite policy with the hope that some of these reasons may be published in a future number of SCIENCE.

JAMES S. STEVENS.
UNIVERSITY OF MAINE.

### COMET $a$ 1904.

THIS comet, discovered by Professor W. R. Brooks on the night of April 16, has an orbit

worthy of note. Lick Observatory Bulletin No. 54 gives elliptic elements computed by Messrs. Curtiss and Albrecht. The extraordinarily small eccentricity (0.17733) together with the major axis (log $a = 0.31970$) at once suggests asteroidal orbits. In fact, so far as size is concerned, the orbit is seen to lie between the orbits of Mars and Jupiter, the comet's perihelion distance being slightly greater than the aphelion distance of Mars. It will also be noticed that the eccentricity is less than that of Mercury's orbit, and, indeed, less than the eccentricities of the orbits of many of the minor planets, including Eros. But the inclination, more than 126,° with consequent retrograde motion, of course sharply distinguishes it from any known planetary orbit.

However disappointing the comet may be in its physical appearance and characteristics, it is to be hoped that a number of observations may be secured and a study of the orbit made, with especial reference to the comet's past and future relations to Mars and Jupiter when in or near its line of nodes.

Ellen Hayes.

Whitin Observatory,
Wellesley, Mass.,
May 4, 1904.

## SPECIAL ARTICLES.

### THE WATER-SOLUBLE PLANT FOOD OF SOILS.*

Data were given showing the amount of phosphoric acid removed by crops, particularly wheat, at different stages of growth. In the case of wheat it was shown that from one square yard of soil 1,106 grams of dry matter, containing 10.18 grams of phosphoric acid, were secured. Does all of this come from water soluble forms? Reference was made to Hellriegel's exhaustive work, showing that 359 grams of water are required to produce one gram of dry matter in the form of spring wheat. It was found that the quantity of water required to produce 1,106 grams of wheat could dissolve only 1.9 grams of phosphoric acid from the soil upon which the wheat was grown. In determining the water soluble phosphoric acid the quantities of soil and water recommended by Whitney and Cameron in Bulletin No. 22, Division of Soils, U. S. Department of Agriculture, were used. The soil was left in contact with the water for fifteen days.

It was shown that if all the water taken from the soil was in the form of a saturated soil solution by physical action alone only 1.9 grams could have been supplied out of a total of 10.18 grams, in water-soluble forms. The conclusion was reached that over 81 per cent. of the phosphoric acid of the wheat crop was secured from forms insoluble in water. Similar data for oats, peas, corn and flax showed that the water-soluble phosphoric acid was only a minor factor in the food supply of the crops.

Some of the data in Bulletin No. 22 were examined. The experiments by Birner and Lucanus were reviewed, and it was shown that all of the data were not given. Instead of being a normal oat crop, as claimed by Whitney and Cameron, it was shown that Birner and Lucanus secured from three to six times as much organic matter when more plant food than that secured in the well water was supplied. There were abnormal amounts of plant food, particularly nitrates, in the well water; over sixty parts per million were present. This was shown to be more than is found in London sewage. The work of Birner and Lucanus can not be questioned, but the application of their results was shown to be inconsistent. It was noted on one page (10) that 'with the chemical methods then available it was realized that the small amount of plant food contained in a soil extract could not be determined with sufficient accuracy to justify the formation of any definite conclusion,' and then on a subsequent page the results of Birner and Lucanus, obtained in 1863–1866, by such methods, are cited as the only evidence that plants obtain all of their food from water-soluble forms.

The action of plant roots upon limestone is accounted for by Whitney and Cameron by the soil water being charged with carbon dioxide. It has been shown that the same result was secured when most seeds were germi-

* Presented at the St. Louis (1903) meeting of the Society for the Promotion of Agricultural Science.

nated between litmus paper moistened with distilled water. The acid tracings of the roots were distinct, and there were no soil solutions charged with carbon dioxide present.

A critical examination of the data given in Bulletin No. 22 shows that the conclusion is not consistent with the figures. To illustrate: On page 32 it is stated that a wheat field yielding 35 bushels per acre contained 2.49 parts of $PO_4$ per million parts of air-dry soil. The most liberal calculations show less than five pounds per acre foot of water-soluble phosphoric acid; accepting the data given as correct, a wheat crop of 35 bushels would remove 40 pounds at least of phosphoric acid. In other words, all of the water-soluble phosphoric acid in this soil to a depth of eight feet by pure physical action alone would not supply this crop with food. To assume that all the water-soluble plant food can possibly be utilized to a depth of eight feet is even an incorrect assumption, because Hellriegel's experiments show conclusively that there is a limit to the capacity of crops for absorbing water.

To assume that a selective process takes place based on physical properties alone and that the plant has the power to take up more water-soluble phosphoric acid than water in which it is dissolved independent of chemical action or solvent power is not correct. Because if such a purely physical action were to take place, the ions of lime, magnesia, etc., forced back into the solution by the withdrawal of the $PO_4$ ions would make the remaining phosphoric acid less soluble. In fact, purely physical action based upon ionization, as claimed by the authors, would be working *against* the plant instead of aiding it in securing plant food.

Most of the data given in Bulletin No. 22 point to just the opposite conclusions from those drawn. It is stated that there are no material differences in the amounts of water-soluble plant food present in soils producing the largest and the smallest crop yields. The figures in the bulletin conclusively show that on a purely physical basis the rich soils do not contain enough water-soluble plant food to account for all of the mineral matter found in the crop. There is only one alternative, namely, since the figures show that there is not enough water-soluble plant food to account for all that there is present in the crop, it must be derived from other and insoluble forms. In fact, no better evidence could be given showing such a conclusion to be logical than the tables in Bulletin No. 22. In short, the conclusions are entirely at variance with the tables.

Harry Snyder.
Agricultural Experiment Station,
St. Anthony Park, Minn.

## THE EDISON MEDAL.

Through the efforts of an organization known as the Edison Medal Association, a fund has been created to establish a medal to be known as the 'Edison Medal,' and the responsibility of annually awarding it has been entrusted to the American Institute of Electrical Engineers.

The Edison Medal Association was founded by the friends and admirers of the great inventor, and in the language of the deed of gift, 'was organized for the purpose of properly recounting and celebrating the achievements of a quarter of a century in the art of electric lighting, with which the name of Thomas Alva Edison is imperishably identified,' and 'for the establishment of an Edison Medal, which should, during centuries to come, serve as an honorable incentive to the youth of America to maintain by their works the high standard of accomplishment by the illustrious man whose name and features shall live while human intelligence continues to inhabit the world.'

The gift was formally made, and the responsibility of conferring it assumed by the institute at its annual dinner given at the Waldorf-Astoria Hotel in New York, on February 11 last, held to not only commemorate the event, but also to celebrate the fifty-seventh anniversary of Mr. Edison's birth.

The fund has been deposited with the Continental Trust Company of New York, and there will be available this year sufficient funds for a medal, which will be awarded by a suitable committee of the institute, soon to be appointed.

The object of this letter is to attract the attention of the authorities of such institutions as may seem, to such authorities, qualified to compete; and the request is hereby made that all such institutions send, through their proper channels, their names to 'The Edison Medal Committee' of the American Institute of Electrical Engineers, 95 Liberty Street, New York City, on or before June 1, 1904, in order that the committee may have before it the names of all institutions which those in direct authority of them believe qualified to comply with the conditions as set forth in the various sections of the deed of gift, as follows:

Fourth. The Institute shall, so long as the requisite funds accrue from the said investments so to be made by the trust company, annually cause to be executed a gold medal, and shall, through a committee to be duly appointed and authorized by it and known as the Edison Medal Committee, award said medal in accordance with the provisions of this clause.

1. The medal shall be awarded to such qualified student as shall have submitted to the institute, in accordance with the provisions of this deed and of the regulations which may be prescribed by the Edison Medal Committee, the best thesis or record of research on theoretical or applied electricity or magnetism.

2. Each competitor for the medal, in order to be qualified, must have graduated and received a degree during the year for which the medal shall be awarded, in some course of study at some institution of learning in the United States of America or Dominion of Canada, which course of study shall include the branch of electrical engineering. The United States Naval Academy and Military Academy are included within the institutions from which competitors may be qualified.

3. Not more than two students may compete in any one year from any one institution of learning; nor may any student compete, unless duly presented for competition through the faculty of the particular institution at which he is a student.

4. The course of study must be one normally representing not less than two years of continuous residence and work.

5. The thesis or record must not exceed six thousand words, not inclusive of words employed in explanation of accompanying drawings.

6. No competitor shall be of greater age than twenty-five years at the day of his graduation in such course of study.

Fifth. The institute shall, through its Edison Medal Committee, forthwith make such rules and regulations, not inconsistent with any of the provisions or conditions of this deed, as may, in their judgment, assist in the proper execution of the trust herein created. The Edison Medal Committee shall immediately upon making such rules and regulations notify the institutions of learning open to competition, of such provisions of this deed, and of such rules and regulations as may properly be communicated to them, and through them to the students at such institutions.

Sixth. The institute will further, through its Edison Medal Committee, issue to each recipient of the Edison Medal a parchment certificate in such form as may be prescribed by said committee, certifying the name of the person to whom said medal is awarded, the date of such award, and such other facts as may be deemed proper by the committee.

The Edison Medal Committee is being selected from among the members of the institute who are not now connected with educational institutions, but who have the necessary early educational training, and subsequent experience, to enable them to critically analyze and justly determine the merits of the theses offered in the various fields of research. This committee will, after organization, communicate such further information as may be necessary to those institutions whose names have been presented in compliance with this invitation, and it is hoped that prompt response may be received in order that no institution justly entitled to consideration may be overlooked.

Bion J. Arnold,
*President.*

American Institute of
Electrical Engineers.

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## *SCIENTIFIC NOTES AND NEWS.*

At the annual meeting of the American Academy of Arts and Sciences, held on May 11, it was voted, on the recommendation of the Rumford committee, to award the Rumford medals to Professor Ernest Fox Nichols, of Columbia University, for his researches on radiation, particularly on the pressure due to radiation, the heat of the stars and the infrared spectrum.

Professor Edward S. Morse has been elected a corresponding member of the

Swedish Society of Anthropology and Geography.

The council of the Royal Astronomical Society has proposed as associates M. Henri Deslandres, of the Meudon Observatory, Professor C. D. Perrine, of the Lick Observatory, and Mr. George W. Ritchie, of the Yerkes Observatory.

Professor Friedrich Kohlrausch, president of the Reichsanstalt, has been elected a foreign member of the Danish Academy of Sciences.

Professor Barrois, of Lille, the geologist, has been elected a member of the Paris Academy of Sciences.

The University of Göttingen has awarded its Otto Wahlbruch prize, of the value of $3,000, to Dr. Wilhelm Pfeffer, professor of botany at Leipzig. The prize is awarded for the most important contribution to science during the past two years.

The candidates selected by the council of the Royal Society have been elected as follows: Dr. T. G. Brodie, Major S. G. Burrard, Professor A. C. Dixon, Professor J. J. Dobbie, Mr. T. H. Holland, Professor C. J. Joly, Dr. Hugh Marshall, Mr. Edward Meyrick, Dr. Alexander Muirhead, Dr. G. H. F. Nuttall, Mr. A. E. Shipley, Professor M. W. Travers, Mr. Harold Wager, Mr. G. T. Walker and Professor W. W. Watts.

The Royal Institution, London, has elected the following honorary members: Professor E. H. Amagat, Professor L. P. Cailletet, Professor J. M. Crafts, Professor H. A. Lorentz, Professor E. W. Morley, Professor E. C. Pickering, Professor and Madame Curie, Professor H. L. Le Chatelier, Professor G. Lippmann, Professor J. W. Bruhl, Professor G. H. Quincke, Professor E. Fischer, Professor F. W. G. Kohlrausch, Professor H. Landolt, Professor L. Boltzmann, Dr. H. Kamerlingh Onnes, Dr. G. Lunge, Professor P. T. Cleve and Professor P. Zeeman.

Dr. W. Schmid has been appointed director of the Bavarian National Museum at Munich.

Professor W. F. King, chief astronomer for the Canadian government, is preparing to undertake the resurvey of the Alaskan boundary in accordance with the recent award of the Alaskan Commission.

M. Alfred Grandidier has been elected president of the French Society of Geography.

Professor Henry B. Ward, of the University of Nebraska, will sail on June 11 for England. He expects to visit the university laboratories in England and on the continent and to attend the International Zoological Congress. He will not return to Lincoln until about September 15.

Dr. Robert Koch has arrived at Cairo from West Africa, and is being consulted by the Egyptian Sanitary Department on the epidemic of bovine typhus now prevalent in Egypt.

Dean Edward C. Kirk, of the Dental School of the University of Pennsylvania, has been made chairman of the committee on organization of the fourth International Dental Congress, which is to be held at St. Louis from August 29 to September 3.

Mr. R. W. Williams, Jr., of the Biological Survey, will soon return to his home in Tallahassee, Florida, to resume the practise of law.

A jury in Brooklyn has rendered a verdict of $20,000 damages in favor of Mr. Arthur MacDonald against the New York *Sun*. The *Sun* published numerous editorials attacking Dr. MacDonald while he was specialist on the defective classes of the U. S. Bureau of Education.

Dr. William Osler, professor of medicine at the Johns Hopkins University, delivered on May 18 the Ingersoll lecture at Harvard University. His topic was 'Science and Immortality.'

Professor Robert Fletcher, director of the Thayer School of Engineering, Dartmouth College, has addressed the students of the Worcester Polytechnic Institute on 'Our Personal Relation to Sanitary Science.'

The Croonian lectures before the Royal College of Physicians of London will be delivered by Dr. J. Rose Bradford on June 7, 9, 14 and 16, his subject being 'Bright's Disease and its Varieties.'

It is stated in the *Condor* that Mr. W. L. Dawson, the author of 'The Birds of Ohio,' intends to move to the state of Washington, where he will undertake, in co-authorship with Mr. J. H. Bowles, of Tacoma, an illustrated work upon the 'Birds of Washington.'

The monument in honor of Benjamin Rush, presented to the nation by the American Medical Association, will be unveiled at Washington, on June 11, at four o'clock in the afternoon. There will be an introductory address by the president of the American Medical Association; an oration on Benjamin Rush by Dr. J. C. Wilson, Philadelphia, and an address of the president of the United States accepting the gift.

The fellowship established at the University of California in honor of the late Professor Joseph Le Conte has been awarded to C. O. Esterly, at present assistant in zoology at the University.

News has just been received by cable that Professor E. J. Marey died on May 16. Physiology has thus lost one of its ablest exponents and a leader in the application of methods of physical research to the study of biological phenomena.

Professor Wilhelm Hiss, professor of anatomy at Leipzig and eminent for his contributions to that science, died on May 1, at the age of seventy-two years.

Dr. George Johnston Allman, F.R.S., for more than forty years professor of mathematics in Queen's College, Galway, has died at the age of eighty years. He was the author of numerous contributions to mathematics, especially on the history of the science.

We regret also to record the death of M. Emile Godfernaux, a well-known French civil engineer, and of M. Charles Soret, who held, since 1879, a chair at the University of Geneva, first of mineralogy and then of physics, on April 4.

Frederick A. Walpole, the botanical artist of the Department of Agriculture, died on May 11, 1904, of typhoid fever, at Cottage Hospital, Santa Barbara, Cal. He was considered the best plant artist in the United States, his drawings having been used to illustrate various reports published by the Department of Agriculture and the Smithsonian Institution, as well as the narrative of the Harriman Alaska expedition. Mr. Walpole was born in Essex County, New York, in 1861, and at an early age moved with his parents to Illinois and later to Portland, Oregon, where he was engaged for some years as artist of a lithographic establishment. In 1896 his drawings of plants came to the notice of the Department of Agriculture and procured for him the position which he has since occupied. His method was to make his drawings from living plants growing under their natural wild conditions. His summers were spent mainly in the field, and his winters at the National Herbarium in Washington, where he completed and perfected his work. The greater part of his drawings remain unpublished, including a remarkable series of colored paintings of the native poisonous plants of the United States, now on exhibition by the Department of Agriculture at St. Louis. He was a member of the American Association for the Advancement of Science, the National Geographic Society and the Biological Society of Washington.

There will be a civil service examination on June 8 for the position of civil engineer in the Philippine Service Bureau of Forestry, at a salary of $2,400. On June 15 there will be an examination for the position of laboratory assistant in the Bureau of Standards at a salary of $900.

The New York Civil Service Commission will hold examination on June 7, for director of Pathological Laboratories, Department of Bellevue and Allied Hospitals, New York City. The salary is $5,000 a year; the successful candidate will be required to devote all his time to the work.

Colonel J. E. Thayer, of Lancaster, Mass., is erecting a museum in that town to contain his valuable collection of birds.

Mr. E. R. Thomas has given $40,000 to the Manhattan Eye, Ear and Throat Hospital, which makes available conditional gifts amounting to $125,000.

THE proposal has been made to erect in Albany, N. Y., an institution, to cost $1,250,000. It is intended for a home for the Albany Institute and Historical and Art Society, as well as the research center of the newly organized society of engineers of eastern New York.

THE sixth International Zoological Congress will, as has already been announced, be held at Berne from August 14 to 19. The congress will be invited to hold its next session in the United States.

IN connection with the mathematical congress which will be held at Heidelberg from August 8 to 13, there will be an exhibition of the mathematical literature of the past ten years, to which mathematicians are invited to contribute. Further information may be obtained from Dr. A. Gutzmer, University of Jena.

WE take from the *Medical News* the following facts in regard to the program of the American Medical Association which meets at Atlantic City from June 7 to 10. On Tuesday evening, beside the Oration on Medicine, the title of which is 'The Importance of Pathologic Anatomy in Clinical Medicine,' by Dr. George Dock, Ann Arbor, Mich., there will be a symposium on research work in the United States. Dr. J. S. Billings, New York, will give an account of the work being done by the Carnegie Institution; Dr. L. Emmett Holt, New York, will speak of the Rockefeller Institute; Dr. Frank Billings, Chicago, of the Memorial Institute for Infectious Diseases; Dr. Harold C. Ernst, Boston, concerning the research work at Harvard, and Dr. Alfred Stengel concerning the William Pepper Clinical Laboratory. On Wednesday evening Dr. W. J. Mayo, Rochester, Minn., will deliver the Oration on Surgery, entitled 'The Association of Surgical Diseases in the Upper Abdomen.' This will be followed by a symposium on 'The Mutual Relation and Duties of the Government Medical Services and the Medical Profession.' Dr. Victor C. Vaughan will talk on the subject 'What Can the Medical Departments of the Army, of the Navy, and of the Public Health and Marine-Hospital Service do for Medical Science?' Surgeon-Major William C. Borden, U. S. Army, will speak on 'What Can the Medical Profession do for the Army?' Surgeon C. F. Stokes, U. S. Navy, will speak for the Navy, and Surgeon-General Walter Wyman will speak for the Public Health and Marine-Hospital Service. On Thursday evening the oration on State Medicine will be delivered by Dr. Herman M. Biggs, New York City, on 'Preventive Medicine; its Achievements, Scope and Possibilities.' Following this will be a symposium in which Dr. William H. Welch, Baltimore, will speak in 'The Bureau of Animal Industry; its Service to Medical Science'; Dr. D. E. Salmon, Washington, D. C., on 'The Service of the Medical Profession to the Bureau of Animal Industry,' and Dr. H. W. Wiley, Washington, D. C., on 'The Bureau of Chemistry and Medical Science.' These evening meetings will be held on Young's Pier, so there will be ample room for the large number that will certainly attend them.

ACCORDING to Mr. George Otis Smith, of the United States Geological Survey, who is the author of a geologic folio on the Mount Stuart (Washington) quadrangle, there is likely to be an increase in the future in the gold production of that area. Mining operations in that field have heretofore been in the hands of people with limited capital, but during the last five years the claims of the small operators have been purchased by large companies, and it is probable that the mines will now be worked more steadily and more economically. The three principal gold-mining districts of central Washington are in this quadrangle. The Peshastin placers were discovered in 1860 and have been worked intermittently ever since. The Swauk placers have been worked rather more steadily since their discovery in 1868. Gold-bearing veins were first located in the Peshastin district in 1873, and in the Swauk district in 1881. Copper and silver occur with the gold in some of the veins of the Negro Creek district. Many of the ores are essentially copper ores, but whether the bodies are extensive enough to warrant their development has not yet been determined. Nickel is also a metal frequently

reported in the assays from this district. The Roslyn Basin is the most productive coal field in the Pacific coast states and it is included mostly within this quadrangle. The coal is a coking, bituminous coal, well adapted for steam raising and gas making. Its clean character and its high percentage of lump fit it for shipment as well as for local use.

## UNIVERSITY AND EDUCATIONAL NEWS.

In the thirtieth general assembly of Iowa, recently adjourned, an attempt was made to remove the departments of engineering from the State University at Iowa City to the State College of Agriculture at Ames. The measure was promptly killed by the vigorous action of the alumni and other friends of the university and an appropriation of $50,000 was made for erecting either the first of a new series of engineering buildings or the wing of a single large engineering hall. An additional appropriation was made for constructing a dam in the Iowa River which will yield on the average over three hundred horse power. This power will be used for lighting and ventilating the university buildings, besides supplying power to the various engineering shops and laboratories. Plans for the proposed structures are being made and work will be commenced at the earliest possible date. An additional $5,000 was appropriated for the better equipment of the bacteriological laboratory, which sum will be increased from the general support fund of the university. Ground will at once be broken for a new museum building to cost about $225,000. The present natural science building of brick, completed in 1885 at a cost of $45,000, will be moved bodily to a new site to make room for the proposed structure, this being in accordance with plans formed several years since for the development of the university buildings and grounds. The new medical buildings are nearing completion and are already partially occupied. All the new buildings are massive fireproof structures, finished in Bedford stone and thoroughly modern in every detail. The total income of the university for the next biennium will exceed $960,000, about one third of which must be used for building.

According to the New York *Evening Post* the Association of Class Secretaries of the Massachusetts Institute of Technology, which is active in opposition to the proposed union of the Institute with Harvard University, reports that over 2,000 of the alumni have signed the petition on the subject addressed to the corporation. Ninety-five per cent. of the graduates approached on the subject sign the adverse petition without qualification, or with unimportant modification; three per cent., while advocating the independence of the Institute, decline to sign because they rely on the judgment of the corporation, or consider the petition too sweeping; and two per cent. decline to sign because they believe that some combination of effort may be possible, or that a union with Harvard is desirable.

The Cornell College of Agriculture is to add a school of landscape gardening to its curriculum.

We learn from the London *Times* that the president of the board of education has appointed a departmental committee to inquire into the present working of the Royal College of Science, including the School of Mines; to consider in what manner the staff, together with the buildings and appliances now in occupation or in course of construction, may be utilized to the fullest extent for the promotion of higher scientific studies in connection with the work of existing or projected institutions for instruction of the same character in the metropolis or elsewhere; and to report on any changes which may be desirable in order to carry out such recommendations as they may make. Sir Francis Mowatt, G.C.B., is chairman of the committee, and Mr. J. C. G. Sykes, assistant secretary in the branch of the board which deals with evening schools, technology and higher education in science and art, has been appointed secretary to the committee.

Dr. William Stirling, professor of physiology in the University of Manchester, has been appointed dean of the Medical School.

Dr. R. Brauns, professor of geology and mineralogy at Giessen, has been called to Kiel.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 3, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *RESEARCH IN STATE UNIVERSITIES.**

THE word research, as used by scientific men, signifies study systematically carried on for the purpose of discovering that which is unknown. It is the seeking for new facts, new forces, new laws and new ideas without direct reference to their utility.

The word *re*-search has been chosen to express this high aim, rather than the same root without the prefix, because in most instances explorations have to be repeated, experiments performed again and again, and the advances made in any direction scrutinized from many points of view before the conclusions reached are deemed worthy of acceptance.

The field of research is not restricted to the laboratory or the library, but is as wide as the universe. It includes the study of man as well as his environment. It is essential alike to the growth of industries and the development of philosophies.

Research, then, is the painstaking endeavor to increase the world's store of knowledge in any department of human thought.

*The Scope of Research.*—One of the most important results of the modern development of industries is the recognition of the fact that discovery is the mainspring of progress. This conclusion, although self-evident, does not seem to have received the recognition it deserves. The creed which needs to be repeated over and over again in the hearing of every intelligent human

* Read before the Research Club of the University of Michigan, January 20, 1904.

being, in order that still greater achievements may be accomplished, is that all man has gained which makes him the superior of the beasts of the fields, has come as a reward for increasing his knowledge of the cosmos in which his lot is cast. The fact that progress depends on and is an outcome of human exertion, should stimulate and encourage all mankind to strive to reach a higher plane. The end in view is the attainment of all possible knowledge, and the application of that knowledge to the increase of man's happiness, the lessening of his burdens, and the decrease of his sufferings. The goal, on reaching which man can say: The bounds of the knowable have been attained, and all possible wisdom is mine! is not in sight. So vast and intricate are the laws and processes of nature and of mind, that the Ultima Thule of human endeavor will never be reached. But to approach and make nearer and nearer approximations to the magnificent ideal, like the alpine climber who seeks to scale some cloud-encompassed peak, we need no other guide than the assurance that all ascending paths lead toward it.

The uplifting of man by providing him with additional powers through research may, as just suggested, be illustrated by the tasks that mountaineers set for themselves. It is true that on a mountain's side all ascending paths lead toward its summit, but some are impassable, others beset with extreme difficulties, and only one perhaps is practicable. The discovery of that way is the mountaineer's hope. Many fruitless efforts must be made, but at last some one climber, more skilled, steadier of nerve, or stronger and more enduring than his companions, discovers the right way and others follow, guided and encouraged by his example and counsel. The foremost mountaineer is an explorer. Following in his foot-steps but improving the path he has made and discovering side excursions from it, others gain glorious alpine gardens, and traverse shimmering snow-fields never before pressed by human foot. In a similar manner, among those who strive to make advances into the realm of the unknown in other directions, some one investigator gifted beyond his fellows, inspired by a new idea, or discovering a new meaning in some well-known fact, like the successful mountaineer, leads the way. When such an advance is made, others are encouraged to follow and a new and wider view of nature is obtained. The all-important fact is that some one shall lead. Leaders in research have appeared from time to time and in increasing numbers as the importance of their services to mankind has become more and more appreciated and the demand for an increase of knowledge more general. Some of the pioneers in research have been greater than others, but all alike have assisted in the great work of extending the boundaries of the known. The recognition of the fundamental importance of research has been slow, and resulted from the observed increase with its advance in material gains, enhanced comforts, greater effectiveness of labor, better health and greater average length of life. As these and other similar results have been recognized, the demand for more knowledge, in order that still other forces might be utilized, has steadily increased, and never before in the world's history has this demand been greater than now.

In a large view of human advancement research work in pure philosophy, from which but little direct aid to industry is perhaps furnished, must be reckoned fully as important as the discoveries of the chemist, the physicist and others, which are widely utilized in enhancing man's material welfare. The discoveries in relation to the flow of electricity, or the studies which furnished a knowledge of the properties of steam, great as have been the re-

sults of their application, it is safe to say, have been no more beneficial to the human race than the researches which made known the mode of development of plants and animals. Electricity and steam have furnished power for the moving of ponderous matter, but *evolution* has given a mental force which has profoundly modified the philosophies of all civilized peoples, and as there is no doubt will be a means of discovering many new truths in the future. Advance in philosophy, ethics, etc., is no less dependent on research than is the growth of manufacture or commerce. But no separation of purely intellectual and purely industrial development is permissible, since, as there is abundant evidence for proving, progress in any department of human activity is followed by gains at other points along the frontier of the domain of the known.

*The Bounds of the Knowable not yet Reached.*—The incentive which leads men to devote their time and energy to research is an unquenchable thirst for knowledge. The unknown has fascinations which in all ages have awakened a response in the human breast. In the earlier stages of intellectual development, the mountains, the ocean, the caverns and other but little-known portions of the earth were peopled in imagination with gods, genii and fairies, both genial and malign. When reason supplants fancy and experiment undermines credulity, the voices from the unknown become still more alluring. They lead the astronomer to explore distant space where he finds no limit; the geologist to trace backward the history of the earth without discovering a beginning; the chemist and physicist to scrutinize the laws governing matter and force without untangling all of their complexities; the archeologist, the historian, the philosopher, the socialist and others to investigate man's estate and development, only to find the records failing before the beginning of thought is discernible; the biologist to describe and classify the manifold ways in which life is encased and study the functions of bone, muscle and nerve, only to learn that the longed-for insight as to what life really is recedes farther and farther as he advances. Along these and many other tributaries of the river of knowledge explanations have been carried without reaching their sources. On every hand and at no great distance, as shown by the explorations that have been made, the known merges with the unknown.

This same conclusion can be indicated in another way: The rate and character of a change that is taking place are frequently indicated by means of a curved line, which shows graphically, perhaps an increase, a culmination and a decline. By this means the rate at which human knowledge has increased might be plotted, but the curve would fail to indicate a maximum and give no suggestion of a decline. The nineteenth century has been termed the 'wonderful century,' and why? Because during that century scientific discovery, followed by invention, was carried on more systematically, more enthusiastically and by a larger number of skilled investigators than during any previous century. The tide of discovery and invention which made itself prominent during the century recently closed, and increased in force as the years of that century increased in number, is still advancing and, as it seems, with continuous acceleration. The intellectual tide-gauges of the world give no suggestion that the nineteenth-century wave of discovery has culminated. On the contrary, there is abundant evidence to show that the rate of intellectual development is still on the increase, and that yet more important conquests in the domain of the unknown than have illuminated the past will be made in the future. On our

graphic illustration of the world's progress, each year extends the curve upward.

The conclusion that the known is but a small fraction in comparison with the unknown is perhaps startling, yet in view of the recency of numerous discoveries and the increasing rate of the returns from more and more careful investigation, such seems to be the ratio of the sum total of man's knowledge to the possible discoveries of the future. To demonstrate this broad proposition, which if true is most stimulating to human endeavor, facts might be presented from any department of knowledge. We are saved the trouble of compilation in this connection, however, by the timely appearance of 'Year Book' No. 1 of the Carnegie Institution.

The officers of the Carnegie Institution, in seeking to learn how they might best apply the money placed at their disposal, obtained assistance from various advisory committees, consisting of from one to six scientific experts, and in several instances the committees themselves sought counsel from other leaders in research both in the United States and in foreign countries. The reports of the committees referred to cover 284 octavo pages, and deal in a broad way with the problems awaiting investigation in several but by no means all departments of learning. Some of the directions in which, in the opinion of the members of the committees, profitable research work can be done, are enumerated below, but it is not practical to review the entire category at this time, and, besides, in several important divisions the precise questions to be asked of nature are not formulated.

From the reports mentioned, we learn that botanists are desirous of broadening their science in at least two directions:

The first pertains to the relation of vegetation to environment in the United States. In this connection, studies are suggested as to the function and effect of the forest in humid regions in reference to the influence of trees on atmospheric moisture, precipitation and run-off, and the converse effect on the forest; and also similar studies respecting the plants of arid regions, for which purpose the establishment and maintenance of a desert botanical laboratory are advocated.

The second recommendation of the advisory committee on botany is in reference to the carrying on of extensive botanical explorations in Central America and the West Indies, for which outline plans are presented.

These are the only ways in which the committee seems to have thought it expedient to recommend the undertaking of research work by the Carnegie Institution, but even a novice in the science of plants can readily see that there are promising lines of work in many other directions.

The advisory committee on physics outlines a broad plan for establishing a well equipped physical laboratory to be devoted to research work in pure physics, with a corps of investigators, together with recommendations in reference to grants of money to be made to persons, societies, etc., engaged in physical research, but does not outline the problems to be attacked.

In reference to investigations pertaining to the earth, which are of mutual interest to both physicists and geologists, the advisory committee on geophysics outlines some of the more prominent problems which demand immediate attention.

Among the salient questions pertaining to the earth's gaseous envelope, or the *atmosphere,* are those of its origin, its mass, its mass-limitations, and its mass-distribution, the potential atmosphere absorbed in the ocean and in the body of the earth, its sources of depletion and enrichment, its function as a thermal blanket over the sea and land, the possible changes in its diathermacy and the relations of these to

great climatic changes, together with many related problems that enter profoundly into the interpretation of the earth's past, and seem to have immense importance to the future of the human race.

In reference to the waters of the earth, or the *hydrosphere*, the geophysicists desire an opportunity to investigate its origin, mass and mass distribution; the constancy or variations in the volume of the ocean and changes in its level in relation to the land; the part which the water-mass plays in the changes of the form of the earth; the origin, constancy, or variation of the ocean's salinity, and many other questions.

Concerning the rigid outer portion of the earth, or the *lithosphere*, the geophysicists would seek for information relating to the origin and maintenance of the continental platforms with their superposed mountains and plateaus, and of the oceanic basins, involving questions of rigidity, distribution of pressures, etc.; the agencies and conditions that make possible the prolonged periods of crustal quiescence recorded on the earth's surface by extensive plains produced by erosion; the nature and causes of the movements in the earth's crust which have produced crumplings and breaks or faults, and upraised mountains and plateaus, and are indicated also in a large way by continents and oceanic basins; the breaking, shearing and folding of the rocks leading on to the general problems of rock metamorphism, and a great group of intricate questions of a chemical and chemico-physical nature, including the flow of rocks, the destruction and genesis of minerals, the functions of included water and gases, the flow of material within the earth, the origin of ore deposits, the evolution and absorption of heat, and other phenomena that involve the effects of temperature, pressure, tension and resultant distortion on chemical changes and mineralogical aggregations.

Within the earth's outer crust lies what is termed the *centrosphere*, concerning which the advisory committee on geophysics states its desires as follows: The themes here are the kinds and distribution of the lithic and metallic materials in the deep interior; the states of the matter; the distribution of mass and of density and the consequent distribution of pressure; the origin and distribution of heat; the conductivities of the interior material under the pressure and heat to which it is subjected; the heat possibilities arising from supposed original gaseous condensation, or alternately from initial impact of aggregation; the heat of subsequent attractional condensation; the secular redistribution of heat within the earth, and its loss from the surface; the possible relations of redistribution of internal heat to volcanism and to deformation, and similar profound problems.

Long as the above category of as yet unsolved problems may seem, it by no means exhausts the lines of earth study suggested to the Carnegie Institution as awaiting elucidation. Laboratory experiments are outlined in reference to the effect of pressure on the melting point of rocks carried on at high temperatures and pressures, and through a wide range of material; the effect of temperature and pressure on thermal conductivity and on elasticity, with reference especially to the transmission through the earth of seismic tremors. Nor is this all; geophysical questions in reference to the relation of the earth to other bodies in the solar system, such as the deformation of the earth owing to the attraction of the sun and moon, thus furnishing a means for testing its rigidity, the history of oceanic tides and their influence on the earth's rotation. These and other questions lead to still greater problems such as the origin of the solar system and even the genesis of the stars.

It is not desirable to weary my readers with a more extended exposition of our ignorance concerning the earth on which we live, as outlined in the 'Year Book' from which citations have just been made, but I may perhaps be pardoned for mentioning that following the presentation of the larger problems referred to, comes a list of sixteen extensive groups of specific questions which demand for their solution the establishment and maintenance for a series of years of an extensive and well-equipped geophysical laboratory.

The immediate lesson illustrated by this catalogue of wants is: great as are the results of the geological studies already made, several chapters of the earth's history have yet to be written and nearly all of the chapters already in print need thorough revision.

In the 'Year Book' cited above, the desire for further knowledge on the part of geographers, meteorologists, chemists, paleontologists, zoologists, psychologists, anthropologists, bibliographers, engineers, physiologists, historians, mathematicians, etc., are outlined, and in each department the importance of pressing on with discovery is clearly and earnestly expressed.

It will perhaps be a surprise to many persons, that in the recommendations for research work made to the Carnegie Institution, astronomy occupies more space than is assigned to any other science. Seventy-three pages are devoted to outline plans of some of the ways in which the study of the heavens can be continued with the promise of valuable returns. If the oldest of the sciences has such hopes for the future, surely the outer boundary of the knowable is far distant.

There is another point of view by which the magnitude of the research work brought to the attention of the trustees of the Carnegie Institution may be estimated. About one half of the plans suggested by advisory committees are accompanied by estimates of cost. This category—including estimates in several instances for laboratories, observatories, biological stations, endowments, etc., and running expenses for a period of five years—calls for an expenditure of about $16,000,000. The expense of all the investigations outlined for a period of five years may safely be placed at $30,000,000, or three times the present capital of the Carnegie Institution. In this connection it is to be remembered that the institution does not propose to undertake any research already provided for by individuals, universities, societies, etc., but to supplement such work or cooperate in carrying it on. The plans to which attention has been directed are for investigations over and above those already initiated or likely to be made without the aid of the Carnegie Institution. And again, to some extent the work outlined is circumscribed by political limits and pertains to the United States.

This brief showing of the problem already in view will, I think, serve to sustain the statement made above, in reference to the vastness of the realm of the unknown which surrounds us on every side. To extend the limits of the known in all the directions in which scientific men are looking would certainly require the resources of many Carnegie institutions, and the time and energy of many generations of investigators.

*Increasing Difficulty of Research.*—In considering the aims of research and the means available for its encouragement, the increasing difficulties in the way of discovery as knowledge increases, should be clearly recognized. Not only this, but the tendency to feel that enough has been accomplished, or in other words, self-satisfaction, needs to be combated. Contentment is not the motto of the enquiring mind.

The close scrutiny, the hard and long-

continued work and the careful mental training required to continue making discoveries in an old field, are seemingly self-evident. In geographical explorations, the discoverer of a new land has a virgin field before him, concerning which the most trivial notes are of value. As exploration progresses, however, and more and more is known concerning a newly discovered land, the problems to be attacked become more and more difficult, require deeper thought, better equipment and broader preparation on the part of the would-be discoverer. But old fields yield rich returns, even to the geographer, as is shown by the conspicuous advances made in physiographic studies in the older portion of America during the past decade.

The increased difficulties of discovery as advances are made might be emphatically illustrated by any one of the older sciences. In astronomy, for example, as every one knows, greater precision has demanded better instruments. While the moon yielded abundant returns when observed with the small telescope of Galileo; to resolve the distant nebulæ, measure the motions of double stars and map the heavens, requires instruments of vastly greater power. To the work of observing and measuring, the astronomer has added the study of the physical condition and chemical composition of the matter composing the heavenly bodies, measurements of the heat emitted by the stars, etc., and in several divisions of his task assistance is had from photography. The increased accuracy demanded and the broadening of the scope of astronomy, particularly by the addition to it of spectroscopic work, has vastly augmented the expense of equipping and maintaining observatories, and also demanded greater and more varied preparation on the part of the men who explore the realm of distant space.

The increase in the size and excellence of the instruments required by astronomers is well known. The great observatories are in sight and open to the public. The beauty and costliness of the modern telescope, so complex with its many attachments that it might well be termed an astronomical engine, are apparent even to the casual observer. Both the interesting methods of observation and the startling results of astronomical study are described from time to time in newspapers and popular magazines. From these and other sources the growing needs of the astronomer as his work progresses are at least recognized, and to a great extent appreciated by the public, and broad-minded citizens have in many instances contributed money freely for the betterment of the tools with which he works.

The increase in size and in costliness of astronomical instruments and the broadening of the scope of astronomy, are but an illustration of what has taken place and is increasing from day to day, in every department of human thought. The chemist, physicist, biologist, meteorologist, geologist and explorers who are following other paths of learning are meeting with greater and greater difficulties and are demanding better facilities, in the way of laboratories, collections, libraries, etc., as their work advances. These demands, although in many instances less obvious to the public than those of the astronomer, are none the less pressing, and fully as important. In each of these departments of research and, as has been stated, in all branches of knowledge, as advances have been made, greater and greater skill and more and more thorough preparation are necessary on the part of the persons engaged in the work. To continue research and place in the hands of inventors, manufacturers, teachers and others still more efficient means for conducting their tasks, it is evident that communities, in order to reap still greater har-

vests, must supply better and more expensive equipment, and furnish still more efficient means for the training of the persons who do research work for them.

*Recognition of the Importance of Research.*—In America three important steps in the recognition of research are marked by enduring movements. These are: the *American Journal of Science,* the first volume of which appeared in 1818, and which has continued to be a record of investigation to the present day; the Smithsonian Institution, organized in 1846, which has for its motto, 'The increase and diffusion of knowledge among men'; and the Carnegie Institution, established in 1902, which, in the words of its generous founder, has for its aim 'the securing for the United States leadership in the domain of discovery and the utilization of new forces for the benefit of man.'

These three monuments mark not only the road of scientific but of industrial advance in America, since the latter follows in the footsteps of the former. The aims of the Carnegie Institution, in particular, should arrest the attention of every so-called practical man, since they recognize a principle that is invading and revolutionizing industry in all of its many branches, namely, the substitution of precise or scientific methods in place of 'rule of thumb,' and the seeking for legitimate gains by the application of original studies to the arts. In brief, it is becoming noised abroad that there is money in research.

In reference to the growing appreciation of the value of research, a few illustrations may not be amiss.

The recognition of the importance of research to the farmer is indicated by the work carried on at public expense by the Department of Agriculture at Washington. Although the so-called practical application of discoveries already available, is the avowed aim of this well-organized department by the government, yet many contributions to pure science have been made in its eighteen sub-departments or bureaus, and at the fifty-six experiment stations under its general supervision and located in nearly every state of the union. Research in pure science is a part of the work of the Weather Bureau, and of the Divisions of Chemistry, Entomology, Botany, Biology, Forestry, Soils, Public Roads, Animal Industry, etc., of the Department of Agriculture and supplemented by experiments in agriculture by nearly 700 men in the many agricultural experiment stations. The results of the investigations carried on in these many related fields of study, not only furnish direct aid to farmers throughout our broad land, but establish safeguards and quarantines about their pursuits, the money value of which can only be reckoned in millions of dollars annually.

The term 'chemical industries' applied to a large group of manufactures such as beet sugar, soda ash, Portland cement, etc., is a recognition of the fact that they are based on the research work of the chemical laboratory. But capitalists are no longer content to await returns from the investigator who may chance to devote his time and energies to the special field in which their money is invested, but establish laboratories of their own and employ research workers who can point out ways of improving processes and enlarging factories. So great is this demand that our universities are being called upon to supply trained men by the score, who are able to originate new methods as well as superintend work already in process. The recognition of the value of research in the factory is even more pronounced in Germany than on this side of the Atlantic, as is indicated by the fact that in that country a single chemical establishment employs continuously more than thirty doctors of science, the best the universities there can turn out, who devote

their entire time to original investigations. As is frankly conceded in England and other countries which are the industrial rivals of Germany, the marked enlargement of her manufacturing industries in the past decade is directly due, as may be said for the sake of emphasis, to her including brains among the raw materials used.

Research in pure physics, as is well known, has led to the mobilization and training of industrial armies, which have built railroads, telegraph and telephone lines, laid ocean cables, and erected wireless telegraphy stations, and in numerous other ways aided transportation and intercommunication, and enhanced the comforts and conveniences of every-day life.

The direct economic value of research work in geology is shown by the fact that nearly every civilized country, and many states and provinces within the limits of larger political organizations, carry on geological surveys. The principal object of such surveys is to furnish assistance in the discovery of materials of economic importance such as building stone, coal, petroleum, iron, etc., but while this is largely routine work and the application of knowledge already acquired, research work is necessary at almost every step. To discover mineral substances of commercial value the far-reaching laws governing the many ways in which such substances have been concentrated, recrystallized, etc., so as to be available for man's use, have to be investigated. In recognition of the fact that the geologist has but entered on the exploration of the treasures of the earth, every national and state geological survey favors research work in a high degree.

A moment's thought will suffice to show that the few instances just mentioned in which research is fostered, do not stand alone. In medicine, hygiene, engineering, economics and many other broad fields of activity the direct utility of seeking for more knowledge is apparent and widely recognized.

These brief statements in reference to the growing recognition of the value of scientific discoveries have been selected from a great number that might be presented, with the hope of making it clear that there is a *demand for research men.* Men are wanted who can not only conduct industries on long established methods, but who have the ability to originate new methods and discover and apply new principles, particularly in the way of doing cheaper and better that which is now being done and of utilizing that which is now being wasted.

Never before in the history of the world has the demand for intellectual leaders of industry been greater than at present. The direct material benefits to be derived from the application of the forces of nature to human ends are now more widely appreciated than ever before. With this appreciation go a demand for fresh explorations and a thirst for the results of research that are most stimulating and encouraging. To persons engaged in the business of education, these considerations must awaken the enquiry: How is this great and growing demand to be met?

*Preparation for Research Work.*—To a large extent, the men who have enlarged human knowledge have been men of genius —with a mental grasp stronger than their fellows. Thousands of people saw apples fall to the ground before Newton formulated the law of gravity, but lacked the ability to deduct the cause from the effect. So in all branches of learning some one man, more gifted than his contemporaries, has led the way into the unknown. Although genius is all important, even the man of genius must have training for his work, in order to make the best use of his exceptional endowments. Just what training is necessary is a difficult question to decide, especially for one who is not a

genius, and not a specialist in the line of work for which a student is to be prepared. To a large extent the specially qualified or exceptional man must decide for himself as to the mental equipment required for his individual work. The education of the exceptional man is a delicate task. Too much training in the methods others have followed may make him an imitator instead of a leader; too little training, and he may fail to acquire the mental tools necessary in his particular line of work. The best that can be done by universities desirous of encouraging their sons and daughters of exceptional ability to make the most of their mental gifts is, seemingly, to furnish them with opportunities to develop; to endeavor to train the body as well as the mind, to educate the hand as well as the head, to supply libraries, laboratories and gymnasiums, to all who may be inclined to cultivate and develop the higher strains of inheritance or the special variations latent in them. From the thousands who present themselves for this arduous work it is the duty of the university to select the few of exceptional ability and encourage them to devote their lives to the task of carrying on research in the direction in which they are especially qualified.

Once the exceptional man is discovered, the purely economic interests of the community, if no higher principle, demand that he be assisted in every practicable way in carrying on his great work. Here again the encouragement of genius is a delicate task. Discovery means close application and long continued and painstaking work. The discoverer, as previously suggested, may be likened to a mountain climber. He must put forth his best efforts, deny himself many of the pleasures of life, and toil on for the most part alone, so far as intellectual companionship is concerned. He is but a man, however, and lavish emoluments may lure him to walk in the customary paths leading through bowers of pleasure, to the neglect of the more rugged ways tending upward; too little aid may leave his task so difficult that a great part of his energy will be consumed in overcoming the difficulties of mere existence.

Both in the education of the thousands in order that the exceptional man may be found, and in the assistance the university may in its own interest extend to him as a research worker, the persons best qualified to act as trustees for the community are the men with sufficiently wide training, and at least an appreciation of the higher and more ennobling aims of discovery, who are interested in similar lines of work. Such men are to a great extent included in the faculties of the higher institutions of learning. Committees from several such faculties, it is to be presumed, would be best able to decide as to what extent the men with new ideas or of exceptional ability should receive financial assistance.

*The Place of Research in the University.*—In view of the several considerations touched upon in the preceding pages—namely, the catholic aims of research; the narrow bounds of the known; the fact that discovery is the all important initial step in applying the materials and forces of nature to man's use; the convincing evidence as to the general and widely spread awakening among the leaders of industry in reference to the economic importance of fresh discoveries; and the growing recognition of the fact that not only skill, but originality, pays—the question presents itself: What should be the attitude of communities and institutions of learning toward research? In this connection communities and institutions of learning may be considered together, since many schools, colleges and universities are supported by public taxation.

Public schools, state colleges and state universities, so far as is declared in the

laws creating them, are maintained for two principal reasons: first, because education tends in a conspicuous manner to promote integrity, refinement and all that speaks for good citizenship; and, second, to train students in various arts and professions in such a way that they will be enabled to serve efficiently the communities in which they live.

The recognized method of attaining these ends, to use a part of the motto of the Smithsonian Institution, is to *diffuse knowledge among men.* The frequently quoted ordinance passed by the Confederate Congress, in 1787, which records the planting of the seed from which the public school system of the United States has grown, reads:

"Religion, morality and knowledge being necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged."

In this and, so far as I have been able to learn, in all subsequent legislation bearing on public education, there is no direct recognition of the fundamental principle expressed in the first clause of the Smithsonian's motto, namely, *the increase of knowledge,* and found in the first of the declared aims of the Carnegie Institution, which reads, *To promote original research, paying great attention thereto as one of the most important of all departments.*

The proclaimed purpose of education has been and to a paramount degree still is, the transmission of knowledge, without endeavoring to add to the assets of the bank on which drafts are made, or striving to train the student to discover new truths for himself. Teachers and professors in state schools, colleges and universities, so far as indicated by their contracts with the institutions they serve, are simply conveyors of knowledge previously gained. In a few universities in America, it is true, chairs of research have been endowed by individuals, and in two notable instances, namely, Johns Hopkins University and Clark University, institutions having research as their primary aim, have been founded by broad-minded citizens. In the main and almost entirely, however, such additions as have been made to the world's store of knowledge by teachers and professors are due to their individual zeal and industry during hours not occupied by routine work in the lecture room or the laboratory.

Admitting the argument sometimes advanced in justification of the neglect of research in state universities, namely, that the duties of such institutions are purely educational, and that they are not supported for the purpose of fostering research, the fact still remains that research is in itself a method of mental training of a high order and demands a place in our institutions of learning on account of its exceptional educational value. As stated by Sir Norman Lockyer in his recent presidential address before the British Association for the Advancement of Science, *research is now generally acknowledged to be the most powerful engine of education that we possess.* The inquiry into the secrets of the unknown necessitates not only rigid mental discipline on the part of its votaries, but is an incentive to exertion to a degree that no other phase of education presents. Not even the desire for technical training in order that pecuniary returns may be had awakens such an earnest desire to know, or stimulates the student to such untiring diligence as exploration in a chosen field. And, besides, in the present stage of the growth of knowledge in order to make fresh conquests, the investigator must become familiar with that which has already been accomplished along the path he is to follow, and at least have a working knowledge of the languages in which the results reached by his predecessors are re-

corded, as well as some understanding of the departments of learning closely related to his specialty. The lesson to be read between the lines in these statements is that research does not supplant other means of education, but supplements them and gives them vitality.

If the primary object of public education is the development of character and the making of good citizens, research must from this point of view also be given a higher place than the mere following in the footsteps of others, since its sole aim is the discovery of truth. The inquiry for truth implies painstaking accuracy, the searching criticism of one's own work and the seeking of criticism from others, the dissipation of false hypotheses, the cultivation of logical methods, fearless abandonment of long established prejudices, the acceptance of conclusions based on oft-repeated experiments no matter how disturbing to former opinions, the discounting of mere authority, and other ennobling attributes of the mind.

In the several particulars just mentioned and more besides, the superior educational value of research over the mere acquiring of knowledge already formulated and recorded in books seems self-evident.

From the considerations briefly and inadequately presented on the preceding pages, at least two important conclusions may be drawn: one is that research furnishes the only means man has of increasing his control over nature; and the other, that in thus enlarging his sway he cultivates his own powers and enchances his chances of still greater advancement. Or stated in other words: an increase in knowledge adds to man's economic resources and at the same time is an educational exercise which develops the higher faculties of the mind.

The attitude that the state should hold toward research is thus twofold; first, to secure for her citizens a knowledge of the materials and forces of nature which can be utilized for increasing their comforts and enhancing their happiness; and second, to supply her students with an efficient means for developing their mental powers and awakening in them a consuming desire for the truth.

This claim for the educational value of research, as already stated, does not imply the abandonment of present methods of education, but simply the adoption of another means of attaining the desired end. While observation should be encouraged at all stages of school and college life, owing to the broad preparation necessary for true research, it can not be expected that the student, unless a genius, will be able to make independent investigations before completing his college studies. The place for definite and final training in research must necessarily be in the university. Such training furnishes the keystone which completes the arch of public education and finishes the structure begun in the grade schools, and must of necessity be fashioned and put in place in the university. It is not until this is done that the university ceases to be a high school of larger growth. In each college of a university a few students are usually graduated each year who desire to continue their studies and earn a master's and later a doctor's degree. These few, by a process akin to natural selection or the survival of the fittest, form a class by themselves and in general, owing to exceptional mental endowments, or more than ordinary diligence, are best qualified of all the sons and daughters of a university to become contributors to the world's store of knowledge, to enter the ranks of teachers, or to assume the duties of the learned professions. It is to the lives of these few that the university looks for her greatest share of reflected honor, and the state for her highest grade of professional men. It is for the encouragement and

advancement of these exceptional students, who are to be intellectual leaders in after life, that the university may reasonably be asked to extend special consideration and assistance during the continuance of their graduate studies.

This would seem to be the highest function of the university, not only because it encourages her best students to strive to attain the higher walks of intellectual life, but because in the process of discovering the man or woman of exceptional ability all her sons and daughters are encouraged to advance to the highest plane their mental endowments permit them to reach.

The place for research work in the university is, then, at the close of the courses of study pursued in her several colleges; that is, in the graduate school, to which only those students who have successfully passed their final college examinations and received the bachelor's degree are admitted. The graduate school might well be named and made in fact the *school of research.* Without such a school a group of colleges should not be classed as a university. As expressed by Hon. Seth Low, in an article on 'Higher Education in the United States,' published in the *Educational Review,* 'The work of the college is to teach that which is already known—the work of the university is, in addition to this, to enquire, to ascertain what lies beyond the line that marks the limit of the known.' In the school of research, the leading idea being the development of originality, it is evident that the professors should be chosen from the ranks of those who have won distinction on account of their original contributions to the branch of knowledge in which they presume to serve as guides. In the school of research, also, professor and student should be co-workers and mutually assist each other. From such comradeship, that intangible something which is transmitted from person to person by association and contact, but can not be written or spoken—we may term it inspiration, or personal magnetism, or perhaps the radium of the soul—is acquired by the student in a greater degree than at any previous time in his life after leaving the caressing arms of his mother. In the school of research professor and student should have the time and facilities their work demands. From such schools, as may reasonably be expected, will come in the future the best trained men and women and the greatest contributions to human knowledge.

Seemingly, all college-bred men must recognize the demands of higher education, every captain of industry appreciate the commercial benefits flowing from an increase in knowledge, and every citizen see that the search for truth is the best method of enhancing morality and integrity and of elevating the human race. The interests of all branches of society are thus primarily centered on research. There is a *demand* that progress be made and that the utmost attainable bounds of the knowable be reached.

Demands of men trained in the law, in medicine, in engineering, etc., have led the trustees and regents of universities to establish and maintain professional schools, and not only the number of men entering the learned professions, but their efficiency, has been increased thereby. As I have endeavored to make clear, there is also a demand which is urgent and pressing, for men who can carry on research work in pure science, and who are qualified to discover new facts, new laws and new forces to be utilized in industry. This demand also deserves to be met by our state universities, in order that the best possible returns may be made to the citizens of a state who, by taxing themselves, support such institutions. While the direct economic returns to be expected from the es-

tablishment and adequate maintenance of research schools at public expense would amply justify such a course, such promises do not stand alone, as research, to use the words of Lockyer quoted above, is the most powerful engine of education known.

The undertakings of communities, as is well understood, are formulated and guided by a comparatively few individuals who see not only the immediate and tangible ends to be gained, but the far-reaching influences that follow. It is from these few informally appointed directors of communities that I venture to ask for due recognition of the fundamental importance of research, both as a means for securing greater returns from commercial pursuits and higher educational training in our universities. When these truths are fully appreciated and clearly expressed by the leaders of communities, the keystone will be placed in the educational arches states have erected, and the continued advance of our country and the attainment of a still greater degree of human happiness be assured.

Israel C. Russell.

University of Michigan.

## SCIENTIFIC BOOKS.

*Grundlinien der anorganischen Chemie.* Von Wilhelm Ostwald. Zweite, verbesserte Auflage. Leipzig, W. Engelmann. 1904. Pp. xx + 808.

The first edition of this book appeared in 1900, and in the course of three years the entire edition of four thousand copies was exhausted. In addition, translations into English and Russian have appeared which have also had a large sale. A translation into French is in course of preparation.

The second edition differs but very slightly from the first. The first half of the first chapter has been rearranged somewhat to secure a clearer presentation of general fundamental conceptions; but aside from this, practically nothing has been done except to correct minor errors appearing in the first edition.

The general plan of arrangement and treatment of the subject matter of this book was sufficiently elucidated in the pages of Science when the first edition appeared. The new departure represented by this treatise consists in an attempt to incorporate systematically the conception of mass action, the phase rule and, in general, the hitherto much neglected influence of temperature, pressure and concentration, as vital factors in determining the progress of chemical reactions. This feature of the treatise together with the constant endeavor of the author to develop ideas inductively and to connect with the substances studied their various important physical and physiological as well as chemical properties, constitutes the valuable, if not the epoch-making part of the book and justifies the remarkable sale of the first edition, which clearly indicates that chemists generally have gladly embraced the opportunity afforded to become acquainted with this new method of presenting elementary chemistry.

On the other hand, the introduction of the 'ions' as a purely chemical conception is unfortunate. While there might possibly have been a justification to thus introduce this conception at the time the first edition was written, the unqualified retention of this notion in the second edition can not be justified; for, since the appearance of the first edition, it has been demonstrated that instantaneous chemical reactions occur in the best of insulators exactly as they do in electrolytes. The use of the term ion in the 'purely chemical' sense as it appears in this book must now be considered merely as a mode of speaking, the term signifying only what has hitherto been expressed by the word radical.

The descriptive part of this book is not unlike that of other books of similar scope, except for an additional remark here and there about ions of this or that kind. Indeed, in most instances Ostwald writes reactions as they have always been written, without using the ionic notation; in so doing he virtually admits that it is not feasible to apply the ionic conceptions logically in most cases. Such an attempt would, indeed, often lead to grotesque distortions rather than to a simple mode of expression which every one could understand.

The weak part of the treatise, then, consists in the undue magnification of the importance of the analogy between gases and solutions and the unsuccessful attempt to make the ionic conception the basis of explaining chemical reactions. To eradicate these undesirable features will necessarily cause a somewhat profound change in the character of the book. The author has everywhere deliberately chosen to entirely omit 'in the interests of the student' a consideration of opinions which conflict with his own. This course can hardly be justified by the additional care which, it is stated in the preface, was exercised in the choice and exposition of the ideas presented, and will only make it all the more difficult to introduce the changes which sooner or later must be made in future editions of the book if it is to continue to be of real value.

LOUIS KAHLENBERG.

## SOCIETIES AND ACADEMIES.

### THE SAN FRANCISCO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY.

THE fifth regular meeting of the San Francisco Section of the American Mathematical Society was held at Stanford University on April 30, 1904. Twelve members of the society were present. A morning and an afternoon session were held. Both these sessions were attended by a number of local teachers of mathematics who are not members of the society. The following papers were read:

PROFESSOR M. W. HASKELL: 'The construction of conics satisfying given conditions.'

PROFESSOR H. C. MORENO: 'On a class of ruled loci.'

DR. D. N. LEHMER: 'On a cylinder the intersection of which with a sphere will develop into an ellipse.'

MR. A. W. WHITNEY: 'The application of actuarial methods to fire insurance.'

PROFESSOR R. E. ALLARDICE: 'On the envelope of the directrices of a system of similar conics through three points.'

PROFESSOR IRVING STRINGHAM: 'Analytical treatment of certain metrical relations in the non-euclidean plane.'

PROFESSOR G. A. MILLER: 'Addition to a theorem due to Frobenius.'

PROFESSOR H. F. BLICHFELDT: 'A theorem concerning the invariants of linear homogeneous groups with some application to substitution groups.'

PROFESSOR H. F. BLICHFELDT: 'The linear homogeneous groups in four variables.'

PROFESSOR M. W. HASKELL: 'Triangles in perspective and the collineations derived therefrom.'

PROFESSOR M. W. HASKELL: 'The construction of a twisted cubic from six points.'

In the absence of Mr. Whitney his paper was read by Professor Stringham. The next meeting of the section will be held at California University on October 1, 1904.

G. A. MILLER,
*Secretary.*

### MINNESOTA ACADEMY OF SCIENCES.

THE meeting of the academy was held in the geological lecture room of the University of Minnesota, on April 11, when the following paper was presented: 'The Gypsum Deposits of New York State,' by Mr. A. L. Parsons, instructor in geology in the University of Minnesota, illustrated by lantern slides.

Through the courtesy of Dr. Frederick J. H. Merrill, director of the New York State Museum, Mr. Parsons was enabled to present the results of his studies on the geology and economic importance of the gypsum deposits of New York before their publication as a state report. These deposits, which were among the first to be discovered and developed in this country, are in the rocks of the Salina age and are closely related to the salt deposits of the state. All the mines of importance are located in a shallow valley extending from Rome to Buffalo, and east of Rome the deposits, though of no commercial importance, are found on the south side of the Mohawk Valley as far east as Schoharie.

The formation of this valley occurred prior to the glacial epoch, and in the region between Syracuse and Rome it has been filled with several hundred feet of glacial and alluvial débris. The presence of this valley is explained by the wearing away of the soft Salina shales and soluble beds of salt and gypsum which lie between the harder limestones of the Niagara and Helderberg periods. With the development of the cement wall plaster and

the Portland cement industries these deposits, which up to that time were used only as a source of land plaster, have become of great importance as a source of plaster of Paris; and, although it is not as pure as Nova Scotia gypsum, it finds a ready market as a wall finish. Plaster of Paris is used at present in place of lime plaster as a wall finish on account of its quick setting, so that the buildings may be occupied without delay. It is also extensively used in the manufacture of Portland cement to retard the set, and, if not more than two per cent is used, it adds materially to the final strength. The manufacture of plaster of Paris depends upon driving off part of the water from gypsum, care being taken not to expel all the water, in which case the plaster fails to set. The hydrate formed in this way is known as plaster of Paris and has the property of again combining with as much water as has been driven off and forming a hard network of fine crystals, or, as it is called technically, the property of setting. The present processes of manufacture were then described, and an historical sketch of primitive and former methods was given.

Mr. Wm. A. Bryan, ornithologist of the Bishop Museum, Honolulu, described the work he was doing in cataloguing and describing the academy's Menage collection of birds of the Philippine Islands. This collection of over 4,500 birds was made by D. C. Worcester and F. S. Bourns in 1890–93, and was the best source of material for Mr. Bryan's purpose of working up all the birds of Polynesia as he has already done for the Hawaiian Islands.

H. Gale,
*Secretary.*

THE GEOLOGICAL SOCIETY OF WASHINGTON.

At the 156th meeting, held April 27, 1904, Mr. N. H. Darton presented a paper on 'Salt Lake South of Zuni, New Mexico,' illustrated by stereopticon. Mr. Darton described the topography and geology of this interesting lake basin, and presented various theories for its origin. His paper will shortly be published in full.

Mr. George H. Ashley then discussed the plain around Middlesboro, Ky., and its relation to the Appalachian structure of the region. A study of the general structure shows a differential yielding of the strata at this point to the tangential stresses that produced the deformation of the Appalachian province. This brought about transverse faultings with horizontal shearing, buckling, and in the shale around Middlesboro highly confused folding, possibly associated with a local downward flexure of the heavy Lee sandstone. The plain is the result of ponding, and a careful study of all the facts seems to indicate conclusively that to produce this ponding there has been recent movement along the old fault planes, or folds, or both. This movement has been at least one hundred and possibly several hundred feet vertical, and is possibly post-Tertiary in age.

The next paper, entitled 'The Significance of U-shaped Glacier and Stream Channels,' was by Francois E. Mathes.

The tendency to assume a U-shaped cross-section is not characteristic of glacier channels alone, and should not be looked upon as the peculiar result of ice action. Channels produced by streams of water exhibit the same tendency, and this type of cross-section should, therefore, be considered characteristic of all stream-worn channels, using the term stream in its broadest sense.

Observation on irrigation canals and ditches teaches that whatever their original cross-sections may be, they will in time be replaced by U-shaped ones. The transformation may be affected: (1) by enlarging, that is by cutting alone, (2) by cutting and filling combined, or (3) by filling alone. The resultant figure is the same in each case, provided the volume and the slope are the same. It further appears that after certain definite proportions of outline have been reached the cross-section no longer tends to change but remains virtually stable so long as the conditions of flow remain unchanged. It is inferred from this that a stream of constant volume, flowing on a uniform slope, tends to evolve a cross-section of certain definite proportions, this cross-section being the one through which the stream can flow with the greatest economy, that is to say,

with the least resistance. This may be termed the normal cross-section.

The shape of this normal cross-section is expressive of a well-ordered interior arrangement of the flowing mass; in other words, it indicates a definite organization of the stream. All streams should be considered as constantly endeavoring to organize; the more efficient their organization, the more economical their flow.

An analysis of the mode of flow was advanced many years ago by D. T. Smith in an essay on the 'Law of the Double Helix.' This theory was briefly outlined as not only affording a probable explanation of the manner of organization, but also satisfactorily accounting for the tendency to produce normal cross-sections of the shape described.

Whether this theory be accepted or not, the fundamental principle of organization stands unchanged. The tendency to evolve normal cross-sections is alone sufficient to establish it.

The application of this principle to the study of stream and glacier channels could not be considered for lack of time.

ALFRED H. BROOKS,
*Secretary.*

THE BIOLOGICAL SOCIETY OF WASHINGTON.

THE 386th regular meeting was held on Saturday evening, April 16, 1904. Carleton R. Ball exhibited specimens of the dead nettle (*Lamium amplexicaule*) showing cleistogamous flowers which are produced abundantly in early spring. Later in the spring the large elongated open flowers are produced and the cleistogamous form disappears.

William R. Maxon spoke on 'Some Termite Nests of Jamaica,' describing three nests collected for the Smithsonian Institution in the vicinity of Hope Gardens, Jamaica, in the spring of 1903, and giving general notes (illustrated by photographs) on the occurrence and habits of *Eutermes ripperti*, the most common species of the island. Occupied nests, being the most perfect, were secured by poisoning several colonies of the insects. The nests secured were all of this species, which occurs abundantly in the lower dry limestone hills up to an altitude of 2,000 feet. They are built without much discrimination upon the ground, in trees, upon old logs, walls, etc. The exterior of the nest consists of a thin granular, delicate fluted covering, very much more delicate than the darker honeycombed interior portion and very readily separable from it. The largest of the nests collected was exhibited, and also a queen cell and alcoholic specimens of queens, workers, nasuti and other forms of the insects. Notes on the life history of *Eutermes ripperti* contributed by E. A. Schwarz were also read.

Vernon Bailey spoke on 'A Simple Method of Preserving Tracks'; and exhibited a specimen of a mold of a wolf's track. A fresh track of a wolf was found in moist sand and melted paraffin from an ordinary candle was poured into it, producing a characteristic mold.

E. S. Steele gave an account of an investigation approaching completion of the globose-headed *Laciniarias, i. e.*, of the group of plant species which have been included under the name *Laciniaria* (or *Liatris*) *scariosa*. The investigation has had the benefit of ample material, comprising, besides that contained in the National Herbarium, numerous loans from institutions and individuals, and representing the territory from Maine to Florida, Texas, the Rocky Mountains and Saskatchewan, the Minnesota region being specially rich. Reference was made to the few hitherto published names applicable to this material. The characters upon which group and specific distinctions must turn were noted and illustrated by drawings, the involucral bracts and the foliage being the most important. The species, of which there were declared to be not less than sixty, were stated to fall into three fairly distinct groups. Mounted specimens of a number of the species were exhibited.

E. L. Morris read a paper on the 'History and Knowledge of the Bush Morning Glory and its Reproduction.' The species was first collected in 1820 and reported as annual. Later it was collected many times, and occasionally with enormous perennial roots which sometimes weighed as much as 200 pounds. Its reproduction is commonly by seed, but another method was mentioned not before re-

ported for the species, namely, the production of lateral root-shoots from the upper part of the narrow roots near the surface of the soil. These root-shoots at a favorable opportunity produce a bud which develops into a new plant. Drawings and specimens were presented to illustrate the paper, which will be published in full in the *Plant World*.

Wilfred H. Osgood,
*Secretary*.

THE CORNELL SECTION OF THE AMERICAN CHEMICAL SOCIETY.

The Cornell Section of the American Chemical Society closed the second year of its existence on May 3, when officers for the coming year were elected. An additional meeting will occur on May 31, at which the retiring president, Professor W. D. Bancroft, will give his president's address. He will discuss the theory of electroplating, and will illustrate his remarks by experiments.

From the first meeting of the Cornell Section in December, 1902, it has grown in numbers and interest. Seventeen new members have been added during the past year and at the present date there are forty-three members all told. A peculiarity of the Cornell Section is that its life and work are centered so entirely within the Cornell University Department of Chemistry. Of its members twelve are undergraduate students; seven, graduate students; and twenty-two, members of the staff of instruction of Cornell University. Two are connected with the Agricultural Experiment Station at Cornell.

The meetings of the year have been well attended and considerable interest has been evinced in original work. Eight sessions were held, with an average attendance of twenty-four members and twenty-five visitors. Eight papers, giving the results of research in the department, were read and discussed.

Dr. J. E. Teeple presented a paper on 'Bilirubin, the Red Coloring Matter of the Bile,' and another on 'The Electrolytic Preparation of Iodoform and Chloroform.' Mr. E. S. Shepherd presented 'An Apparatus for the Electro-deposition of Metals using a Rotating Cathode.' Mr. J. M. Bell discussed the 'Vapor Pressure of Tobacco.' Mr. F. C. Robinson gave a description of 'A New Boiling Point Apparatus.' Dr. H. R. Carveth discussed the data obtained from a study of distillation, boiling point methods of molecular weight determination, and vapor composition. Dr. A. W. Browne presented some data and conclusions from experiments performed elsewhere in conjunction with Dr. W. P. Bradley on the 'Resistance of Glass Tubes to Bursting Pressure.' Mr. I. Baum read a paper which was produced in collaboration with Mr. F. J. Schwab, on 'Electrolytic Copper Refining.'

Aside from this original work the section has enjoyed several interesting addresses. Professor G. W. Cavanaugh outlined the 'Applications of Chemistry to Modern Agriculture.' Mr. J. A. Bonsteel gave a résumé of the work of the United States Soil Survey. Professor E. L. Nichols and Professor E. Merritt jointly gave an address on 'The Behavior of Indicators at Low Temperatures,' which they illustrated by experiments. Dr. E. M. Chamot discussed the results of the examinations of Ithaca waters during 1903. Dr. W. R. Orndorff lectured on the history and development of 'The Manufacture of Indigo from Coal Tar.'

The most notable meeting of the year was addressed by Professor Ernest Rutherford, of McGill University, on 'The Emanations of Radium.' His experimental lecture was enjoyed by a large audience of students and others interested in radioactivity.

The Cornell Section begins the next year with the following officers:

*President*—Professor E. M. Chamot.

*Vice-President*—Dr. J. E. Teeple.

*Secretary-Treasurer*—Mr. F. C. Robinson.

*Executive Committee*—The above officers *ex-officiis* and Dr. H. R. Carveth, Mr. W. S. Bishop and Professor W. R. Orndorff.

*Councilors*—Dr. G. C. Caldwell and Professor L. M. Dennis.

William C. Geer,
*Secretary*.

THE NEW YORK ACADEMY OF SCIENCES.
SECTION OF GEOLOGY AND MINERALOGY.

The section held its regular meeting Monday evening, April 18, with the chairman, Professor James F. Kemp, presiding. The

evening was principally devoted to a paper by Dr. Arthur Hollick, of the New York Botanical Garden, entitled 'A Canoe Trip down the Yukon River from Dawson to Anvik.'

Dr. Hollick said in brief: The trip was made under instructions from the United States Geological Survey, with the special object of collecting paleobotanical material, from which to determine the age of certain exposures in central Alaska.

The party consisted of Dr. Hollick, Mr. Sidney Paige, field assistant, and Mr. John Rentfro, cook and general camp assistant. The start was made from Seattle, Wash., on June 1, 1903, by steamer to Skagway, Alaska, where they arrived on June 5 and remained until June 11, waiting for the ice to break up in the Yukon River. On June 11 the route was by railroad to Whitehorse, Yukon Territory; June 12–15, by steamboat down the upper waters of the Yukon to Dawson, Yukon Territory, where a nineteen-foot Peterborough canoe was purchased and the trip down the river begun. The trip was ended at Anvik, Alaska, August 12, after about 1,100 miles of the river had been explored and about 1,800 pounds of specimens had been collected and shipped. The highest point north was reached at Fort Yukon, July 2, just beyond the Arctic circle.

The Yukon River occupies what was until quite recently a broad estuary. Subsequent elevation of the land resulted in the draining of the estuary and the formation of the present river valley, which has cut its way down through the estuary deposits, leaving these as broad benches or terraces. Mastodon and other remains of extinct animals indicate the Pleistocene age of the deposits. One of the finest exposures is at the 'Palisades,' just below Rampart.

The width of the river varies from one to ten miles, and the main channel is constantly shifting. It pursues a meandering course, sometimes impinging on one side of the old valley, sometimes on the other; but for long distances it flows through the middle. Where it occupies the latter position, it is generally broad, with a current of about four miles per hour, and filled with innumerable wooded islands, mud flats and sand and gravel bars, which render navigation more or less a matter of guesswork, on account of the impossibility of telling where the main channel may be and the liability of running into a blind slue or long circuitous channel around an island. It was often found advisable to climb up the river bank to a considerable elevation in order to determine, by means of an extended view, where the correct course lay. Where hard rocks were exposed along the river banks, or a short distance away, these were subjected to careful examination in regard to their lithologic, paleontologic and stratigraphic characters.

Amongst the interesting results obtained were: (1) the determination of the Tertiary age of certain sandstones above Rampart; and (2) the determination of the Cretaceous age of other sandstones and shales further down the river in the vicinity of Nulato. At one locality, a unique fossil flora was found, totally different from any heretofore known in America, consisting of cycads of Lower Cretaceous types, mixed with angiosperms belonging to what have always been considered Upper Cretaceous types.

Only a preliminary study has been made of the material collected, which will eventually be carefully examined and reported upon for the United States Geological Survey.

The paper was illustrated with about seventy lantern slides, showing the principal topographic and geologic features of the route.

*The Grand Soufrière of Guadeloupe, an Analogue of Mont Pelé:* EDMUND OTIS HOVEY.

Dr. Hovey showed twelve lantern slides illustrating the Grand Soufrière of Guadeloupe, and stated that the field evidence indicated that the present active cone of this volcano was closely analogous to the new cone and spine of Mont Pelé, Martinique, that is to say that it had been pushed up bodily into its present position, or had welled up through the conduit in such a viscous condition that contact with the atmosphere rendered it too rigid to flow. At the base of the cone on the north there is a gently rising flat area, apparently the segment of a circle indicating the position

of a part of the rim of a crater in existence before the construction of the present cone.

The map shown in connection with the paper was prepared by M. Léon Leboucher for the Club des Montagnards of Guadeloupe. This club has recently celebrated the first anniversary of its founding, and its report shows that it has done a great deal in a short time toward the opening up of roads and paths to the Soufrière, making the highest and one of the most interesting mountains of the Lesser Antilles readily accessible to visitors.

Edmund Otis Hovey,
*Secretary.*

## DISCUSSION AND CORRESPONDENCE.

### THE METRIC SYSTEM.

To the Editor of Science: Permit me to differ from Mr. William Kent as to the conclusion to be drawn from Professor W. Le Conte Stevens's article on the metric system. If he will substitute for the word 'impossibility' the word 'possibility' I shall be glad to agree that Professor Stevens's 'article is useful, however, in showing the possibility of the general adoption of the metric system in its present form by the people of this country.' There seems to be every probability that one will not have to live to be very old in order to see by experience this possibility become a fact, in this country as well as in England, which now seems likely to precede us in this reform, as she has in various political ones. I can not share the desire of Professors Lane and Stevens to temper the metric system to the conservatism of the American people by adopting its values disguised in the sheep's clothing of the present non-system. I believe that the intelligence of our people is not insufficient to enable them to drink their milk by the liter with as much gusto as by the quart, and to realize that six cents a liter is six dollars a hectoliter, even if a Greek prefix is involved. It takes a bold man to assert that the American people can not do what the French and Germans have done, and that they will not be able to see the advantage of it. If 'the people can not be compelled to adopt a nomenclature that is thrust upon them as a substitute for that to which they have always been accustomed' we should have no decimal system of currency to-day, for the people were very much accustomed to pounds, shillings and pence, but seem to have been willing to be compelled to adopt dollars and cents (what an outrageous, foreign, difficult Latin word!), and in fact, seem even to prefer them. Is the inch more sacred than the pound? The engineer will reply, yes, and here we come to the kernel of the whole matter. It is the mechanical engineers and builders of machine tools who are delaying the adoption of the metric system. Now, while these persons constitute a very important part of the community, they do not constitute the whole of it. Drills, taps and dies, rigs and jigs are not the only argument that should be brought into the question, although engineers would have us believe it. Of course, it will cost us something to change our system, and this is a visible item. It is costing us more not to change it, but this is not so visible. I do not care to go into the arguments here, but merely to protest against the argument from conservatism, and also to suggest that the best way to find out the facts about the metric system is to apply, not to the engineers, who have not used it, but to the scientific men who have used it. The attitude of the conservative engineer toward changing the system of measurement is very similar to that of Cæsar toward the Senate: 'Can not is false, and that I dare not, falser; I *will* not' change.

Arthur Gordon Webster.

### ZOOLOGY AND THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.*

This work has just come into my hands and I have examined it for references on the subject to which most of my attention is given, viz., Cœlenterata. The data given below will indicate the value of the catalogue, so far as Cœlenterata are concerned, in comparison with two other well-known bibliographic undertakings, the 'Bibliographia universalis' of the Concilium Bibliographicum and the *Zoological Record.*

For the year 1901, the Concilium Biblio-

* 'The International Catalogue of Scientific Literature.' First Annual Issue, N, Zoology [for the year 1901]: 1904 (February).

graphicum has 155 entries (omitting 3 that should be credited to 1902, and adding one erroneously dated 1902). The *Zoological Record* for 1901 contains 153 titles. Of these 1 (54)* is for 1899; 11 (36, 39, 42, 44, 78, 117, 124, 128, 134, 140, 141) for 1900; and 1 (92) belongs to 1902, leaving 140 for 1901. The volume for 1902 furnishes 5 for 1901.

The 'International Catalogue' for 1901 contains 92 references, at least 3 of which belong to 1902, leaving 89.

There are in my own card catalogue for 1901 222 entries. Of these:

| | Entries. |
|---|---|
| The Concilium Bibliographicum published.... | 155 |
| The *Zoological Record* for 1901 adds........ | 54 |
| The 'International Catalogue' for 1901 adds.. | 7 |
| Collected by myself and not in any of the preceding .............................. | 6 |
| | 222 |

The Concilium Bibliographicum procured 70 per cent. of the references; the *Zoological Record* for 1901† 63 per cent.; and the 'International Catalogue' 40 per cent.

Thus it will be seen that the 'International Catalogue' contains less than half the references on this subject, and that two other far superior bibliographies are being published.

It is scarcely necessary to cite specific omissions. Works of importance published in practically every country are left out, England, Canada, Australia, the United States, Russia, Germany, etc. If other zoological subjects can be judged by the Cœlenterata, to make the 'International Catalogue' of any special value the work must be done much more thoroughly, and should appear with reasonable promptness.

T. WAYLAND VAUGHAN.

WASHINGTON, D. C.,
May 13, 1904.

* These numbers in parentheses are those prefixed to the papers in the list of titles of the *Zoological Record.*

† The additions made in 1902 are not included in calculating this percentage.

NON-EDUCATION OF THE YOUNG BY PARENTS.

SOME of our new nature students appear to think that it is necessary that the young of animals should be taught to take care of themselves by their parents, or, at least, that they shall learn by example. While glancing over some of the controversial articles on the subject that have lately appeared, some cases that bear directly on the question came up to memory.

There are a few 'annual' fishes whose entire cycle of life is performed within a year. Professor Robert Collett, of Christiania, in 1878, recorded the biographies of a couple of those which are quite common in Europe. They belong to the family of gobies or gobiids and are the *Aphya pellucida* and *Crystallogobius nilssonii.*

Although very distinct in their generic as well as specific characters, they agree in their physiological characteristics. From June to August they are at the height of their sexual maturity and males are trenchantly differentiated from females. After spawning they 'seem always to keep together in enormously large shoals' and are the easy victims of innumerable other fishes, large and small. Before winter supervenes they are supposed to have all died off; 'it is probable that no specimen lives more than one year and after the close of the breeding-time [everyone] dies without living through another spawning; consequently, these fishes are really annual vertebrates.' The species as represented by adults become extinct annually and are only represented by eggs. Where then are the teachers or exemplars?

A more familiar group of fishes furnishes us with an analogous case of death after spawning, though perhaps less striking than that of the annual gobiids; that group is the genus *Oncorhynchus,* including the hook-nosed salmons of the west coast. All the American species—five in number—have their alimentary canal so shrunken and defunctionalized soon after their entrance into fresh water that they can not assimilate food, and besides they literally become worn out and used up, so that soon after spawning and milting they die; not one lives to go to salt water and return to fresh again. Consequently the young can not have the benefit either of parental instruction or of learning through

association with their elders. Where now are the teachers and exemplars?

THEO. GILL.

PRICE OF THE REPORTS OF THE HARRIMAN EXPEDITION.

I DESIRE to correct an error in my review of volumes three and four of the Harriman Expedition, published in the preceding number of SCIENCE (May 2, 1904). As I have been informed, the price which I quoted from a trade-list of the publisher applies to volumes one and two of the series and not to subsequent volumes. The price of volumes three and four, the ones reviewed, is $5.00 per volume.

ISRAEL C. RUSSELL.

## SPECIAL ARTICLES.

### AN ENEMY OF THE COTTON BOLL WEEVIL.

SPECIMENS of the cotton boll weevil were obtained in eastern Guatemala in 1902, during a visit made to that country in order to study the culture of coffee and rubber, for the United States Department of Agriculture. The insects, which were collected on the request of the Division of Entomology, were not found on the cotton cultivated by the Indians, but were very common in the flowers of the tree cotton growing spontaneously near a native house, a short distance from the cotton field. The beetles were secured in a rather inaccessible part of Alta Vera Paz, seldom visited by naturalists or other travelers. It lies between Cajapon and Sepacuite, and is inhabited only by primitive Indians and a very few Spanish-speaking 'natives' of mixed blood.

The Indian variety of cotton seemed very small and unpromising, only one or two bolls being borne on a plant; it seemed very strange also that so small a variety should be planted while the large tree cotton was so ready at hand. It was learned, however, from Mr. Kensett Champney, who has a most thorough acquaintance with the agricultural habits of the Indians, that this was the only variety of cotton planted by them in this district, and the one exclusively relied upon to furnish material for their native fibers. The absence of the weevils from the small Indian cotton was reported when the specimens of the beetles were brought back to Washington, but the diminutive size of the plant seemed to forbid any recommendation of profitable utility in the United States.

Later on, with the increasing acuteness of the boll weevil question and the voting of a special appropriation by Congress for the study of means of protection against its ravages, the existence of a variety of cotton in Guatemala which seemed not to be subject to the attacks of the boll weevil was recalled, and it seemed to the authorities of the Bureau of Plant Industry that every clue should be followed up. The Secretary of Agriculture authorized an investigation of the Indian cotton of Alta Vera Paz, to ascertain whether it possessed, in reality, any quality enabling it to resist the boll weevil, or to learn other causes of its immunity from the attacks of the insect. The custom of the Indians to plant their crops every year in tracts of land recently cleared by burning suggested an alternative possibility that if not actually resistant to the weevil the cotton might have an almost equally valuable tendency to quick growth, thus enabling a crop to be obtained before the weevils had time to become injuriously numerous. The importance of securing early varieties has been emphasized as the result of the investigations of the boll weevil in the United States.

In this part of Guatemala the present season has been much more rainy that that of 1902, and the cotton is much larger. Well grown plants bring to maturity from ten to twenty bolls of fair size, and even more. A thorough search shows that the weevil is present and able to injure the cotton, but reveals also an active enemy which keeps it in check. This is a large reddish brown ant which is attracted to the cotton by the food which it secures from three sets of extra-floral nectaries. Each leaf has a nectary on the under side of the midrib, from one to two centimeters from the base. Each of the large bracts of the involucre has a circular or broadly oval nectary close to the stem, and there is a third series of three nectaries at the base of the calyx, between the pair of small bracts alternating with the larger divisions of the involucre, of which

they seem to be, morphologically speaking, the stipules. Nectar is also to be found between the calyx and corolla, but no bees, flies, or other winged insects were observed visiting the flowers except beetles, sometimes the boll weevil, but much more often a small black staphylinid of very active habits. To these and to the very small black ants which are also occasionally present in numbers on the cotton, the large brown ant pays no attention, but the weevil is attacked on sight and becomes an easy prey.

The ant's mandibles are large enough to grasp the weevil around the middle and pry apart the joint between the thorax and abdomen. The long, flexible body is bent at the same time in a circle to insert the sting at the unprotected point where the beetle's strong armor is open. The poison takes effect instantly; the beetle ceases to struggle, and with its legs twitching feebly is carried away in the jaws of its captor. As with many other insects when stung by wasps the paralysis is permanent; even when taken away from the ants the beetles do not recover. The adroit and business like manner in which the beetle is disposed of, in very much less time than even the briefest account of the operation could be read, seems to prove beyond question that the ant is by structure and by instinct especially equipped for the work of destruction, and is, in short, the true explanation of the fact that cotton is successfully cultivated by the Indians of Alta Vera Paz, in spite of the presence of the boll weevil. Instead of congregating in large numbers on the cotton in the immediate vicinity of their nests the ants have, as it were, the good sense to spread themselves through the field, from 2 to 4 or 5 usually being found doing inspection duty on each plant. In some places there seemed to be not enough ants to go around, and here the beetles were more numerous. Rarely, too, certain flowers or branches seemed to have been overlooked, beetles being found on the same plants with the ants. In such instances, indeed, the young flower or boll was generally riddled with punctures as though many beetles had availed themselves of the rare opportunity of feeding undisturbed.

Cotton-growing among the Indians is something of a special art, the community being supplied by a few men aware, as it were, of the secrets of the business. They know nothing about the weevil and its ravages, and ascribe such damage as occurs to other harmless insects, or even to superstitious causes, such as the failure of the owner to abstain from salt at the time of planting. The ant, however, is definitely associated in their minds with cotton, and they do not expect to secure a good crop unless these insects favor the plants with their presence. Some of the Indians give the ant a special name, *kelep*, not applied to any other species, but it is also referred to as 'the animal of the cotton.'

In the neighborhood of Secanquim, on the coffee estate of Messrs. Champney and Company, where the most of our observations have been made, the ants are by no means widely distributed, and the cultivation of cotton is confined to very narrow limits, where it is planted year after year in closely adjacent places, or even on the same ground. In one instance the same Indian has planted cotton on the same hillside for upwards of forty years, with no failure to secure a crop except in one year, as he explained, when he was sick and did not sow! Such facts preclude, of course, any explanation based on the theory of temporary immunity secured from burning over the land or by planting in a new place in which the beetles have not had time to congregate. The cotton is sowed in October or November, a very rainy part of the year, when land can not be cleared by burning, and the weeds are pulled out and thrown with the dead corn stalks and brush into piles, which would protect the beetles rather than destroy them. The perennial tree cotton also furnishes permanent breeding-places, so that the conditions are most favorable to the propagation of the beetles in large numbers. The ants, however, are evidently able to hold them in check, and thus permit the regular cultivation of an annual variety of cotton by the Indians.

Ethnological data show that the weaving of cotton cloth was practised in tropical America for many centuries before the arrival of

Europeans, and the probability is great that the plant itself is a native of this hemisphere. In being carried to other countries it was taken beyond the reach of both the friends and the enemies which had developed with it. The boll weevil has migrated northward with the extension of the area of cotton cultivation into Mexico and Texas, but the ant has not yet followed. The question now is whether it can be induced to do so. The Mexican entomologists seem not to have found the ant in that country, in the northern states of which the weevil has been reported as very destructive.

That the ants are so localized in their distribution in this part of Guatemala has undoubtedly served the better to demonstrate their value as protectors of the cotton plant; it suggests also, with other facts, the probability that they are not native here, but have spread eastward in smaller or larger colonies as the forests were cleared away by the Indians. The present occupation of the eastern districts of Alta Vera Paz by the Indians does not date back more than a few generations, though abundant evidence of much more ancient inhabitants is found in the apparently primeval forests. The ants, like the Indians, probably came from the dry, open interior plateau region, where the center of the aboriginal cotton industry of Guatemala is still located, and where another visit to the ants is to be paid in the next few days. To establish such an origin for this useful insect would greatly increase the probability of its successful introduction into the United States. The acclimatization of a thoroughly tropical animal requiring continuous heat and humidity could scarcely be hoped for. If, however, the cotton ant can survive a long dry season and perhaps cold weather in the table lands of Guatemala it might easily learn to hibernate in Texas, as has the boll weevil. The ant, indeed, is much better able to protect itself against frost, since it excavates a nest three feet or more into the ground. That it is a reasonably hardy insect is shown also by the fact that several individuals have survived confinement for twelve days without food, and seem now to be thriving on a diet of cane juice. To take worker ants to Texas will be, evidently, a very easy matter, but to secure queens and establish permanent colonies may require considerable time and experiment, and a thorough study of all the habits of the species.

Although the cotton seems to be especially adapted to attract the ant by means of its numerous nectaries, the insect is not, like some of the members of its class, confined to a single plant or to a single kind of prey. It was observed running about on plants of many different families, and it attacks and destroys insects of every order, including the hemiptera, and even centipedes. On the other hand, it does not do the least injury to the cotton or to any other plant, as far as has been ascertained, and it can be handled with impunity, having none of the waspish ill-temper of so many of the stinging and biting ants of the tropics. Since where once established it exists in large numbers and seeks its prey actively, it is a much more efficient destroyer of noxious insects than the spider or the toad. It seems, in short, not unlikely to become a valued assistant in the agriculture of tropical and sub-tropical countries, if not in temperate regions. The farmer has a new and practical reason to 'consider the ant.'

An accumulation has been made, of course, of seeds, specimens, photographs and notes bearing on the cotton, beetles, ants and many other collateral matters not to be mentioned here. Even this brief preliminary report should not close, however, without an acknowledgment of the many favors of Messrs. Owen and Champney, owners of the Sepacuite estate, and of Mrs. Owen. Without the kind invitations, hospitality and extensive local knowledge and cooperation of these generous friends, it would have been quite impracticable to visit the Indian cotton district of the interior of Alta Vera Paz in 1902, or to ascertain the existence of the cotton ant in the present season.

O. F. Cook.

Sepacuite, Guatemala,
May 11, 1904.

ZYGOSPORE FORMATION A SEXUAL PROCESS.

In a paper now in process of publication the writer has given a detailed account of a

somewhat extended investigation on the method of reproduction in one group of the common molds, and since many of the facts which have been discovered are at variance with the conclusions of other investigators, and since the problems involved have a general biological interest, it has seemed desirable to publish the following preliminary summary of the more important results obtained.

Among the Mucorineæ, as is well known, the usual form of reproduction is by means of non-sexual spores in sporangia, while the sexual method by means of zygospores is unknown in the great majority of species, and even where it has been reported our knowledge of its occurrence in about four fifths of the cases is based on the recorded observations of single individuals. For over thirty years the phenomena of reproduction by zygospores in these plants have been an object of considerable investigation among students of fungi, and as a result a number of conflicting theories have arisen as to the significance of the process and the conditions by which it is induced. Such conclusions as have been reached have in general been based on the assumption that external conditions of one kind or another were the essential factors concerned, and, while the process has been generally regarded as a primitive type of sexual reproduction, some investigators have denied that any sexuality is involved in zygospore formation.

In the experimental investigations made by the present writer in order to determine the conditions associated with zygospore production in more than a dozen different species, results have been obtained which may be summarized as follows:

Zygospore production in the Mucorineæ is conditioned by the inherent nature of the individual species and only secondarily or not at all by external factors.

According to their method of zygospore formation, the various species among the Mucorineæ may be divided into two main categories, which may be designated as *homothallic* and *heterothallic,* and which correspond respectively to monœcious and diœcious forms among the higher plants.

In the homothallic group, zygospores are developed from branches of the same thallus or mycelium and can be obtained from the sowing of a single spore. Although it has been currently assumed that all mucors belong to this class, it comprises but a very small percentage of the species and contains the only forms from which heretofore it has proved possible to obtain a constant production of zygospores. *Sporodinia grandis,* the only common species, is very frequent on decaying agarics, etc., and has served as a basis for experimentation in a majority of the investigations dealing with this subject.

In the heterothallic group, comprising a large majority of the species, zygospores are developed from branches which necessarily belong to thalli or mycelia diverse in character, and can never be obtained from the sowing of a single spore. Every heterothallic species is, therefore, an aggregate of two distinct strains through the interaction of which zygosporic reproduction is brought about. If inoculations of these two opposite strains of a given species are so disposed that their mycelia can grow together, there will be developed, at the region of contact, a distinct dark line produced by the accumulation of zygospores formed between filaments of the opposite strains. *Rhizopus nigricans,* the common bread mold which is used by nearly every elementary class in cryptogamic botany, may be taken as the type of this group. An accidental mixture of its two strains has been kept under cultivation for nearly ten years and as the 'Harvard strain' has furnished zygospores for class work to many botanical laboratories in this country.

In an individual species these sexual strains show in general a more or less marked differentiation in vegetative luxuriance, and the more and less luxuriant may be appropriately designated by the use of (+) and (—) signs respectively. In a few forms, no differentiation has been as yet detected; in others, one strain shows a less vegetative vigor when cultivated under unfavorable conditions; in the majority, however, the differentiation is evident from the marked difference in the gross appearance in cultures of the two opposite strains; and in one form, not only the habit of growth, but

the size of the spores are so diverse in the (+) and (—) strains that systematists generally would feel justified in describing them as separate species.

In heterothallic species, strains have been found which from their failure to react with (+) and (—) strains of the same form have been called 'neutral,' and a similar neutrality may be induced by cultivation under adverse conditions. A table under preparation to determine the relative abundance and distribution in nature of the (+), (—) and neutral strains of *Rhizopus* has so far shown that, although neutral strains are not uncommon, the majority of the cultures, obtained from various localities abroad and in this country, belong to either the (+) or the (—) strain.

In all species of both homo- and heterothallic groups in which the process of conjugation has been carefully followed, the swollen portions (*progametes*) from which the gametes are cut off do not grow toward each other, as currently believed, but arise as a result of the stimulus of contact between more or less differentiated hyphæ (*zygophores*) and are from the outset always normally adherent.

In some species the zygophores have been demonstrated to be mutually attractive (*zygotactic*).

In the *heterogamic* subdivision of the homothallic group, a distinct and constant differentiation exists between the zygophoric hyphæ and the gametes derived from them, but in the remaining homothallic forms and in all heterothallic forms no such differentiation is apparent. Thus, while in the heterothallic species the sexual difference inheres in the whole thallus of either strain, in the homothallic forms it is confined to the conjugating branches of a single thallus.

A process of imperfect hybridization will occur between *unlike* strains of different heterothallic species in the same or even in different genera, or between a homothallic form and *both* strains of a heterothallic species, and distinct white lines are produced in many cases at the regions of hybridization.

By taking advantage of this fact it has been possible to group together in two opposite series the strains of all the heterothallic forms under cultivation. When thus grouped, the (—) or less luxuriant strains will fall in one series, while the (+) or more luxuriant will be included in the other.

From the foregoing observations it may be concluded: (*a*) That the formation of zygospores is a sexual process; (*b*) that the mycelium of a homothallic species is bisexual; (*c*) while the mycelium of a heterothallic species is unisexual; (*d*) and further that in the (+) and (—) series of the heterothallic group are represented the two opposite sexes.

The writer intends during the coming year to continue his investigations on the subject of sexuality in the lower fungi, and would be greatly indebted to any mycologists who might be willing to assist him by sending culture material of any of the forms of the Mucorineæ which may be found producing zygospores.

Albert Francis Blakeslee.
Cryptogamic Laboratory,
Harvard University.

ON THE DEVELOPMENT OF PALISADE TISSUE AND RESINOUS DEPOSITS IN LEAVES.

In connection with the experimental investigation of the causes of xerophily in bog plants, new evidence as to the factors involved in the development of palisade cells and resinous deposits has been obtained. It has been found possible, in the case of *Rumex Acetosella* L., to greatly modify its external appearance and internal structure by growing it under various ecological conditions. When grown in moist conditions, with soil and air temperatures approximately the same, the leaves attain a relatively large size and their tissues are exceedingly loose. A poorly developed palisade of one cell-layer and three layers of spongy parenchyma, beneath it, make up the mesophyll. The epidermis is composed of large turgid thin-walled cells, having a very delicate cuticle on the outside.

When grown on dry sand the leaves are notably thickened, reduced in size and the margins become revolute. The mesophyll is very compact and consists of a palisade of two to three cell-layers and a spongy tissue of two cell-layers. The epidermal cells are small and

their outer walls are notably thickened. A well-developed cuticle is present.

It has been found that all of these xerophilous characters may be produced by growing the plant in an undrained wet sphagnum substratum, whose temperature is maintained several degrees below that of the air. This effect is obtained even in subdued light. Further, under these conditions the drops of oil or resin, so characteristic of bog xerophytes, are formed in the epidermis and the cells adjacent to the bundles. Such resinous deposits occur also in the plants grown on dry sand, but are wanting under favorable moisture conditions. It is believed that these modifications are, in the case of the bog habitat, a response to the unfavorable conditions for absorption by the roots, occasioned by the low substratum temperature and lack of proper aeration.

That palisade tissues may be greatly increased or developed in shaded conditions is also evident. The experiments suggest that even when such a response is obtained in strong light, it is to be correlated with drouth rather than with light. The increased transpiration brought about by direct insolation, as it increases the temperature and decreases the relative humidity of the air, would seem to be an efficient cause for palisade development. The elongated cells of the palisade, therefore, appear to be an adaptation for the ready transferrence of food materials in the leaf tissues, under the stress of a reduced water supply. The analogy of dry sand habitats and undrained wet bog habitats is certainly indicated.

The details of these experiments and others tending in the same direction will be published elsewhere. EDGAR N. TRANSEAU.

UNIVERSITY OF MICHIGAN,
May 11, 1904.

ALBINO BROOK TROUT.

AMONG the brook trout hatched at the Adirondack Hatchery, Saranac Inn, N. Y., in March, 1902, there appeared to be some distinct albinos. There were about fifty of these fry out of an entire hatching of 800,000 ordinary brook trout eggs, taken from both wild and confined trout. These albinos were put by themselves, and four reached maturity.

Two of them are typical albinos. They are the same in outline as the ordinary brook trout. The skin is white, mottled with an ochraceous yellow, colored with the typical red and yellow spots. The fins are white, with the red band and yellow mottling. Eyes red. The general appearance of the fish is delicate, and the bones are apparently visible through the seemingly transparent skin. As these fish were reared in captivity they have been confined to the ordinary fish races, and fed on ground liver. One is a male, the other a female. The former now measures seven inches in length; the latter, nine inches.

The other two fish are a grayish white, with dark fins and black eyes.

On November 10, 1903, when the two albinos were twenty months old, they were stripped for eggs and fertilization. At this time their combined weight was approximately one half pound, the female being much the larger. Mr. G. E. Winchester, foreman of the Fish Hatchery, made the following experiments in fertilization: viz., first cross, 527 eggs from female albino × albino male; second cross, 103 eggs from female albino × natural male; third cross, 424 eggs from natural female × albino male.

The eggs, after fertilization, were placed in the hatchery races the same as all brook trout eggs. The hatching began March 1, 1904, and continued until the thirteenth of the month, the period of incubation being the same as that of the ordinary brook trout egg.

The result of the hatching was as follows: From the first cross 32 hatched, or approximately 6 per cent.; from the second cross 43 hatched, or approximately 42 per cent.; from the third cross 416 hatched, or approximately 98 per cent.

At the present time—one month after all the fish were hatched—the following number is living: from the first cross 20, or 62 per cent.; from the second cross none; from the third cross all, or 100 per cent.

The weakness of the pure albinos is indicated by the fact that only 6 per cent. of the eggs proved fertile, and several of these are

not perfect fish. Yet they have the characteristics of the albino parents.

Of the fry from the second cross 42 per cent. hatched; but none were alive at the end of one month. Some of them were imperfect in form, and were colored more like the natural male parent, but not entirely so.

From the third cross all the eggs were fertile except eight—a loss of but two per cent.—and all are living at the end of thirty days. There are practically no cripples, and the coloring is typical of the natural female parent.

The silver gray albinos did not spawn. They have the appearance of barren fish.

These fish were exhibited by this department at the New York state fair last fall and attracted much attention.

C. R. Pettis.

Forest, Fish and Game Commission,
Albany, N. Y.,
April 15, 1904.

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## *BOTANICAL NOTES.*

### WEEDS USED IN MEDICINE.

Under this title the United States Department of Agriculture issues an interesting bulletin (Farmers' Bulletin, No. 188) prepared by Alice Henkel, assistant in drug and medicinal plant investigations. The author calls attention to the fact that many of the common weeds of the farm and garden possess medical properties, and in some cases might be collected and made a source of revenue. Thus in his fight with the plant pests in his fields the farmer may actually turn them to some account, by collecting and preparing them for the market as crude drugs. Directions are given for collecting and curing, and suggestions are made as to their disposal when ready for the market. They are first considered under roots, barks, leaves and herbs, flowers and seeds. Following this are descriptions of some of the more common weeds which have medicinal importance, illustrated by a number of good figures. No less than twenty-four species are taken up in this part of the bulletin. It should prove very useful to many farmers and gardeners.

### THE DATE PALM IN AMERICA.

In a recent bulletin (No. 53) of the Bureau of Plant Industry of the United States Department of Agriculture, Walter T. Swingle makes a report of his investigations of the date palm as grown in Algeria, and of the attempts to introduce it into California and Arizona. The purpose of the bulletin, as stated by the author, "is to call attention to the peculiar suitability of the date palm for cultivation in the hottest and most arid regions in the southwestern states, and to its remarkable ability to withstand large amounts of alkali in the soil. The most intense heat, the most excessive dryness of the air, the absence of all rainfall for months at a time during the growing season, and even the hot, dry winds that blow in desert regions, are not drawbacks, as in almost all other cultures, but positive advantages to the date palm, enabling it to mature fruit of the highest excellence." The author shows that the Salton Basin in California 'is not only the most promising region in the United States, or in North America, for the culture of the best sort of dates, but that it is actually better adapted for this profitable culture than those parts of the Sahara Desert where the best exported dates are produced.' It is shown to be probable that this single region is capable of producing dates enough to supply the demand for the whole country. Other regions in California, Nevada, Arizona, New Mexico and Texas are discussed, the conclusion being that in all of these states date palms of certain varieties may be grown with profit.

From the bulletin it appears that there are three principal types of dates cultivated by the Arabs, viz: 'soft dates,' which are very sugary and include the sorts with which we are familiar; 'sour dates,' which contain a much lower percentage of sugar, not enough, in fact, to preserve them; 'dry dates,' which are not at all soft or sticky when ripe, and which may be stored and kept indefinitely. None of the last are to be found in the American markets, and scarcely any of the second type. Of the 'soft dates,' the variety which bears the name of 'Deglet Noor' is the most famous. It is very late in maturing,

but yields a fruit of great excellence. We are assured that this variety can be grown in the Salton Basin, California.

WOODY PLANTS IN WINTER.

K. M. WIEGAND and F. W. Foxworthy, of Cornell University, have published a handy pamphlet which should be very useful to foresters, horticulturists, schoolteachers and others who do not have such an intimate personal acquaintance with trees and shrubs as will enable them to recognize them in their winter condition. By means of carefully made keys the genus of any woody plant, native or planted in the state of New York, may be determined with a good deal of certainty. The authors hope to bring out later a similar set of keys to the species.

DOCTOR AUGUSTIN GATTINGER, BOTANIST.

BORN in Munich, Germany, in 1825, educated in the Gymnasium and University of Munich, emigrated to Tennessee when twenty-four years of age, practised medicine and studied the flora of Tennessee for many years, published 'Trees and Shrubbery Adapted to the Soil and Climate of Nashville' (1878), 'Tennessee Marbles' (1883), 'Botanical Fragments' (1884), 'The Tennessee Flora' (1887), 'The Medicinal Plants of Tennessee' (1894), 'The Flora of Tennessee' (1901), died in his home in Nashville, July 18, 1903. Such is the brief summary of the life of a pleasant, genial, industrious man who loved plants, and studied them because he loved them.

In the *American Historical Magazine* for April, 1904, there appeared a sympathetic biographical sketch (28 pp.) of the life of Dr. Gattinger, by Robert A. Halley, accompanied with a fine portrait. This has been printed separately for distribution among botanical and other friends. CHARLES E. BESSEY.

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## SCIENTIFIC NOTES AND NEWS.

THE University of Toronto conferred, on May 27, the honorary degree of LL.D. upon President Harper, of the University of Chicago; Professor Minot, of Harvard University; Professor Saunders, of the Dominion Experimental Farm, Ottawa; Mr. W. S. King, Dominion astronomer, and his assistant, Mr. Otto Klotz; and Captain Deville, surveyor-general, Ottawa.

CAMBRIDGE UNIVERSITY conferred, on May 28, the following doctorates of science: Hendricus Gerardus van de Sande Bakhuysen, president of the Royal Academy of Sciences, Amsterdam, professor of astronomy in the University of Leiden; Andrej Sergejevich Famintsyn, member of the Imperial Academy of Sciences of St. Petersburg; Edmund Mojsisovics, Edler von Mojsvár, member of the Imperial Academy of Sciences, Vienna; Gustav Retzius, member of the Royal Swedish Academy of Sciences, emeritus professor of anatomy in the University of Stockholm; Eduard Riecke, member of the Royal Academy of Sciences, Göttingen, professor of physics in the University of Göttingen; Wilhelm Waldeyer, secretary of the Royal Prussian Academy of Sciences, Berlin, professor of anatomy in the University of Berlin.

THE senate of the Royal University of Ireland has resolved to confer, *honoris causa*, the degree of doctor of science on Sir William Crookes, F.R.S., and on Professor James Dewar, F.R.S.

A COMPLIMENTARY dinner was given on May 16 in London to Major-General E. R. Festing, C.B., F.R.S., upon his retirement from the post of director of the science division of the Victoria and Albert Museum.

PROFESSOR R. S. WOODWARD, dean of the faculty of pure science, will be the delegate from Columbia University at the celebration of the fiftieth anniversary of the founding of the University of Wisconsin, on June 5 to 9.

DR. L. O. HOWARD, chief entomologist of the Department of Agriculture and permanent secretary of the American Association, has returned to Washington after investigations in the southern states and Mexico.

PROFESSOR R. W. WOOD, professor of experimental physics at the Johns Hopkins University, has gone to Europe, where he will carry on investigations during the summer.

Dr. J. B. Johnston, professor of zoology at West Virginia University, has been granted leave of absence for the year 1904–05. He will spend July and August at the Bermuda Biological Station, from September 1 to March 1 at the Naples Zoological Station, and the remainder of the time in Germany. At Naples he will occupy the Smithsonian table.

President Andrew D. White is expected to return to America in time for the commencement exercises of Cornell University.

Mr. Austin H. Clark, of Boston, who is now on a collecting trip among the less-known islands of the British West Indies, has been elected a fellow of the Royal Geographical Society of London.

The Carnegie Institution has made a grant to Mr. A. F. Blakesley, of Harvard University, to enable him to spend next year abroad continuing his investigations in mycology. He will leave after the close of the Harvard Summer School.

It is announced that Mr. Marconi will return to Cape Breton early in June to conduct the trans-Atlantic wireless service.

The following provisional program of evening lectures at the Marine Biological Laboratory, Woods Hole, Mass., has been arranged. Other lectures will be announced later.

July 2. Mr. Lynds Jones. 'The Migrations of Birds.'

July 5. Professor Jacob Reighard. 'The Breeding Habits and Secondary Sexual Characters of some Brook Fishes.'

July 7. Professor A. D. Mead. 'The Houseboat as a Biological Laboratory.'

July 11. Professor E. P. Lyon. 'Physiological Rhythms in Cleavage.'

July 15. Professor A. P. Mathews. 'The Physical Basis of some Vital Phenomena.'

July 20. Professor C. O. Whitman. 'The Evolution of Color Pattern.'

July 29. Dr. R. M. Yerkes. 'Automatism and Intelligence in Frogs.'

August 1. Dr. R. M. Strong. 'The Colors of Birds.'

August 3. Dr. Theo. N. Gill. 'The History of the Ichthyology of Massachusetts.'

Dr. G. S. Huntington, professor of anatomy in the College of Physicians and Surgeons, Columbia University, will give the Shattuck lecture before the Massachusetts Medical Society, on June 7.

According to the program, lectures were to be given before the Royal Institution as follows: On May 24 Mr. H. F. Newall began a course of two lectures on the Solar Corona; on May 26, Mr. N. G. Wells delivered the first of two lectures on Literature and the State; on May 28, Sir Martin Conway began a course of two lectures on Spitzbergen in the seventeenth century. The Friday evening discourse on May 27 was delivered by the Prince of Monaco on the Progress of Oceanography; and on June 3 Professor Svante Arrhenius lectured on the Development of the Theory of Electrolytic Dissociation.

Dr. George Oliver, a fellow of the Royal College of Physicians, London, has presented to the college the sum of $10,000 in trust for the endowment of a lectureship or prize to be called the Oliver-Sharpey Lectureship or Prize, in memory of the late William Sharpey, F.R.S., professor of physiology in University College, London.

Professor William Henry Pettee, professor of mineralogy, economic geology and mining at the University of Michigan since 1875, died suddenly at Ann Arbor on May 26. He was born in 1838, graduated from Harvard in 1861 and studied subsequently for three years in the Royal Saxon Academy of Mines. He was assistant in chemistry and instructor in mineralogy at Harvard University for four years and went to the University of Michigan in 1871 as assistant professor. He was a fellow and, in 1887, general secretary of the American Association; a member and, in 1880, vice-president of the American Institute of Electrical Engineers, and a member of the Geological and Philosophical Societies.

The death is announced of Wilhelm von Siemens, a member of the eminent family which has contributed so much to the advancement of electrical science and himself an able inventor.

There will be a civil service examination, on June 22, to fill a vacancy in the position

of assistant chemist, at $1,400 per annum, in the Bureau of Standards.

The sixth International Congress of Physiology will be held at Brussels, in the Institut Solvay, from August 30 to September 3, 1904, under the presidency of Professor Heger. One meeting will be devoted to the report of the International Commission appointed at Cambridge in 1898 for the unification of standards in physiology (Association de l'Institut Marey) and to the nomination of a committee of arrangements for the following congress. If the number of communications warrants, special sections, for example, in physiological chemistry or in experimental psychology, may be organized, as at Turin. Further information may be obtained from Dr. Auguste Slosse, local secretary, Institut Solvay, Parc Léopold, Brussels, Belgium.

The Royal Geographical Society held its annual meeting on May 15; the medals and other honors were presented to those whose names have already been announced. The annual address of the president, Sir Clements Markham, was largely concerned with the British Antarctic Expedition, but geographical progress in other parts of the world was also described. It was stated that efforts are being made to secure $600,000 for the erection of a new building for the society. The annual dinner of the society was held on the evening of the same day, when speeches were made by the president, Sir Harry Johnston, Sir William Ramsay and others.

The Chicago Academy of Sciences has secured the collection of lower coal measure plants made by Dr. John H. Britts, of Clinton, Iowa. The collection contains many species named by Lesquereux besides numerous cotypes of species described by David White in Monograph 37, U. S. Geological Survey, on the 'Fossil Flora of the Lower Coal Measures of Missouri.' The collection was obtained through the generosity of Mr. Francis S. Peabody of Chicago.

A correspondent writes to the London *Times* from Alexander on May 6: "Dr. Koch has concluded his investigations into the question of the cattle plague. His report, which was laid before the ministry yesterday, is disappointing to those who anticipated prompt and effectual measures for the eradication of the disease. The learned bacteriologist considers the plague an extremely mild form of rinderpest, and one more nearly allied to Texas and Transcaucasian fever, the germ conveying the infection bearing also some analogy to the parasite found in coast fever in West Africa. His suggestions are confined to advising the government to pursue the measures already adopted, such as the application of injections and the isolation of infected animals. Dr. Koch sailed on May 6 for Marseilles."

We learn from *Electrical World* that a deputation of Canadian electrical interests has waited upon the minister of inland revenue asking that the government establish an electrical standardizing bureau, to be maintained independent of any other branch of the public service, and placed in charge of a qualified electrical expert, at whose disposal should be placed trained assistants and proper facilities. The delegation also asked that the law be amended so that if any device was found in the possession of any one to prevent the proper registration of electric current, it should be *prima facie* evidence for his prosecution and conviction.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

Mr. John D. Rockefeller has given the Case School of Applied Science $200,000 to be used for building and equipping laboratories for physics and mining engineering. The buildings will be erected during the coming year.

Yale University will receive as residuary legatee over $250,000 from the estate of William B. Ross, a lawyer of New York City, who died on January 14 last. A portion of this sum will be used for the erection of an addition to the library building.

The will of the late Professor Maxwell Sommerville provides $20,000 for the preservation and care of the collection of engraved gems and ethnological collections given by him to the University of Pennsylvania some years ago.

The forestry department of the University of Michigan has received a gift of about ninety species, including over five hundred specimens of forest trees, from Robert Douglas's Sons, forest tree nurserymen, of Waukegan, Ill. The material was selected at the invitation of the donors, by Professor Roth and Mr. Davis, of the forestry department, and will at once be set out on the Saginaw Forest Farm.

The new range of greenhouses of the New Hampshire College of Agriculture was opened on May 20. There were over two hundred visitors in attendance, to whom a reception was given by Professor F. W. Rane, head of the department of horticulture. The greenhouses have been erected at a cost of $7,000, appropriated by the state, and offer many facilities for instruction and research.

A plan for the reorganization of the faculty of the department of medicine of the University of Pennsylvania has been approved by the trustees, whereby the faculty membership has been extended to the clinical, associate and assistant professors, to the associates and lecturers and to a limited representation from the subordinate staff. The scheme provides for an executive body or council, to be composed of the heads of departments in fundamental subjects and two representatives of the specialties. Jefferson Medical College has adopted a similar plan, electing all the clinical professors to a full professorship.

Two pieces of foreign educational news may be noted: The resident members of the Oxford convocation voted by a large majority to permit those not in priests' orders to be examiners in the school of theology, but convocation, composed largely of absent clergymen, rejected this measure by a vote of 676 to 278. This is perhaps only natural conservatism, but the Prussian Chamber of Deputies on the same day, May 17, adopted a resolution which is reactionary, namely, that the elementary national schools shall, as a rule, be either Protestant or Roman Catholic, that each school shall contain, as a rule, pupils belonging to one faith only and that these pupils shall be instructed by teachers who profess their own creed. A somewhat similar bill was proposed by the minister of education in 1891, but owing largely to opposition in academic circles was defeated, whereupon the minister and the president of the ministry, Count von Caprivi, resigned.

There is a vacant instructorship in Chemistry in Denison University, Granville, Ohio. Instructor W. B. Clark has been granted leave of absence to pursue graduate work in the University of Chicago.

We are asked to state that a position as assistant in physiology is open for applicants in the University of Pennsylvania.

It is announced that Professor George Trumbull Ladd has resigned his chair of philosophy at Yale University.

Professor Charles Baskerville, of the University of North Carolina, has been elected professor of chemistry in the College of the City of New York.

At Cornell University, Dexter S. Kimball has been appointed Sibley professor of mechanic arts, in charge of the Sibley shops. Professor Kimball succeeds Professor John L. Morris, who, after continuous service since 1868, will become professor emeritus in June. Instructors have been appointed as follows: C. N. Haskins in mathematics, H. H. Cochran, W. J. Fisher and G. L. Manning in physics, W. C. Geer in chemistry, G. D. Hubbard in geology and E. A. Gray and P. Anderson in anatomy.

Dr. R. Burton-Opitz has been appointed adjunct professor of physiology in Columbia University and has been assigned a seat in the faculty of pure science.

At the University of Nebraska, Mr. G. E. Condra has been promoted to a professorship of geology and Mr. H. S. Evans to an adjunct professorship of electrical engineering.

Appointments have been made at McGill University, as follows: Dr. R. Tait Mackenzie, to be lecturer in anatomy; Dr. A. A. Robertson, to be lecturer in physiology; J. R. Roebuck, to be lecturer in chemistry; Dr. W. S. Morrow, to be associate professor of physiology; Dr. A. G. Nicholls, to be associate professor of pathology and bacteriology; A. S. Eve, to be lecturer in mathematics, and Dr. Coker, to be associate professor of engineering.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 10, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *HERBERT SPENCER'S AUTOBIOGRAPHY.**

THE autobiography of a great man, the publication of which during his lifetime is expressly interdicted by him, unavoidably raises the question as to the possibility of disinterested action. Mr. Spencer has, indeed, in his 'Autobiography' discussed the motives that prompted his work, and has shown that egoism and altruism are inextricably mixed in the composition of these motives. But he speaks only of his philosophical works, all of which appeared during his lifetime, and in which he may, therefore, be supposed to have a personal interest. But here is a work of no mean proportions, in which he knew he could take no interest after it appeared. In many cases the motive may be explained by the belief on the part of the authors that they will continue to exist and remain cognizant of all that is to take place, and will, therefore, know just what the effect of their action is to be upon the world at large. But no such motive can be alleged in the present case, for he himself says: 'as I have no belief in anything to be gained in another world, it can not be otherworldliness that moved me'; and again: 'with death there lapses both the consciousness of existence and the consciousness of having existed.' This is not the place to discuss such a question, but in the minds of many it can not be suppressed.

The 'Autobiography' of Herbert Spencer must not be regarded as a mere pastime and incidental episode in his career, but as

* Two volumes. New York, D. Appleton and Company, 1904, 8°.

an integral part of his life work. Whereas his other works constitute his philosophy of nature, his 'Autobiography' constitutes his philosophy of life. It is a large work, seriously written, costing him years of labor. It was not written after his main work was done as a closing retrospect to his laborious life, but was executed in the midst of his busiest days, while he was hard at work on his 'Synthetic Philosophy.' It was begun, he tells us, in May, 1875, *i. e.*, while he was writing the first volume of his 'Principles of Sociology,' and the main portion of it was finished on his sixty-ninth birthday, April 27, 1889, or while he was writing the first volume of his 'Principles of Ethics.' It is true that four years later he wrote some 'Reflections,' which occupy the last sixty pages of the 'Autobiography,' in which some of the events of that period are alluded to, but this is not, like the rest, a chronological record. But even if we place the conclusion of this work at the year 1893, which is the date of the second volume of the 'Principles of Ethics,' we find that it ended before the appearance of either of the last two volumes of the 'Principles of Sociology,' although parts of the second volume had been published. The third volume bears date, 1897. There were then still four years of activity after the last word of the 'Autobiography' had been dictated before the conclusion of the 'Synthetic Philosophy.' He survived his great work six years, and there are evidences that he was by no means idle during that time. In a letter dated May 4, 1897, although he characterizes himself as a 'wreck,' still he speaks somewhat doubtfully of his ability to complete his "remaining task—revision of the 'Principles of Biology.' " Why he did not bring his 'Autobiography' down to some such date, or even later, has not yet been explained.

This work has done the important service of dispelling a large amount of popular error with regard to Herbert Spencer's life and career. The prevailing opinion has been that he was a typically 'self-made man.' He has been represented as having had to struggle with adversity, and has been held up as a proof of the theory that great abilities are certain to assert themselves whatever the obstacles may be in their path. His life shows that, on the contrary, he was highly favored by circumstances. While of course without his talents his achievements would have been impossible, still, given such talents, there was scarcely any reason why he should not have accomplished great things. He does not himself favor the Galtonian doctrine, but fully recognizes his indebtedness to circumstances. He admits that but for the three legacies that were one after the other left him by his two uncles and his father, he could never have completed his system. But he was even more indebted to the help of influential friends, freely volunteered, and by a whole train of favorable circumstances, fully set forth in his 'Autobiography.' Indeed, his very environment was sufficient to bring out all that was in him. On intimate terms for the greater part of his life with such men as Huxley, Tyndall, Hooker, Lubbock, Mill, Lewes and Bain, belonging to the same clubs, taking long walks, and having constant discussions with them, the stimulus must have been enormous.

He enters quite elaborately into the question of genealogy, and shows that his ancestors embodied extremely heterogeneous elements, elements, as he maintains, calculated to implant in him most of the characteristics that he possessed. To a groundwork of immemorial English and a little Scotch there was added a strain of the French Huguenot, probably tinctured with Bohemian Hussite protestantism. It must not, however, be supposed that this ancestral heterogeneity rendered him any the

less typically English, for the one leading characteristic of the whole Anglo-Saxon race is the complete mixture of all the numerous races—Saxon, Danish, Norman, British, Welsh, Scotch, etc.—that entered into the composition of the later inhabitants of that historic isle.

Herbert Spencer is commonly represented as being the type of a self-educated man. Nothing could be farther from the truth. The son of a professional teacher belonging to a long line of teachers, he was surrounded by educational influences from his very birth. So far from struggling to educate himself, his main efforts as a boy seem to have been to escape from the perpetual drill of the domestic school. His father finally sent him away to be further drilled by his uncle, but it was the same old story, geometry forever. His youthful escapade from this latter educational treadmill is very amusing. Many boys of some pluck, when they imagine themselves ill-treated at home, 'run away,' but Spencer, thinking himself overtasked by his uncle, *ran home,* from Hinton to Derby, a distance of nearly 150 miles! He admits that it was largely homesickness, and one can compare it to nothing but the way a domestic animal, removed from the spot to which it has become wonted, will seize the first opportunity to go back, regardless of the distance, and guided by that little-known 'sense of direction' that some think to be located in the semicircular canals of the ear.

But whatever his treatment may have been, and it certainly was never severe, Herbert Spencer as a boy was always being taught. His education was not sporadic and one-sided, but methodical and all-sided. He is usually represented as wholly ignorant of Greek or Latin and of modern languages. In so far as this is true it was due to his distaste for them, for he complains of being taught them. At that day, before the natural sciences had come to receive the place they now occupy in education, all pupils belonged to one or the other of two classes, those that loved mathematics and hated languages, and those that loved languages and hated mathematics. Spencer belonged to the first of these classes. But he had to learn languages and dead languages at that, and any close observer of his style can see that he did learn them sufficiently to affect his style. It is clear that he always had the derivation of a word in mind when using it, and that he knew enough Greek and Latin to apply their principles to his own language. He seems to have known very little German, but he not only read French, but spoke it well enough to act on one occasion as an interpreter.

All that is left, therefore, of the prevailing notion about his education is that he was not university trained. He thought that a great advantage, and never tired of citing proofs that university training spoils a man for all usefulness and fills him with a mass of useless rubbish. Whether he would have done any better or worse had he taken a university course may be a difficult question to answer, but his whole reasoning on the subject is unsound because it is based on the exceptional man and takes no account of the average man. Indeed, his entire philosophy of education is permeated by this vice. His book on education may be said to rest on the assumption that every child has a father or a mother or both capable of properly educating him or her. One has only to look around to see how absurd this assumption is.

Herbert Spencer belonged to the middle class; though not rich, he was by no means poor. He never did manual labor of any kind, and none of his ancestors at all recent belonged to the laboring classes. He explains the smallness of his hands by this

fact. He never knew what it was to be in want or to fear that he might come to want. The only work of a bread-winning kind that he ever did was while serving as a civil engineer in the construction of certain railroads. This occupied nine years of his life (1837–46), from his seventeenth to his twenty-sixth year. The several positions that he held during this time were not sought, but were offered to him, generally, as he admits, through the influence of his friends rather than from any superiority of his own in the business. More than once he gave up a good position and returned home for awhile. But his father's latch-string was always out and he was welcomed back whatever might be the cause of his coming. He alleges as one reason for not holding his positions longer, his 'lack of tact in dealing with men, especially superiors,' and says: "Advancement depends rather on pleasing those in authority than on intrinsic fitness. * * * Never did it enter into my thoughts to ingratiate myself with those above me. Rather I have ever been apt, by criticisms and outspoken differences of opinion, to give offense." In other words, he was no toady, and never cared to 'crook the pregnant hinges of the knee where thrift may follow fawning.' But he was never removed from any position. He always voluntarily quit work, usually with the regret of his employers.

The only other period of his life that he was subject, even nominally, to the will of a superior was during the five years (1848–53) that he was sub-editor of the *Economist*, and this position he also voluntarily relinquished. This was an easy position and left him much leisure time, as may be judged from the fact that during this period he wrote his first book, 'Social Statics.' It was to be hoped that in his 'Autobiography' he would give a full explanation of how he came to choose the title 'Social Statics.' He does, indeed, discuss a number of titles that had occurred to him, but leaves it to be assumed that the one finally adopted was originally his own. To find the true explanation it is necessary to go to the revised edition of that work published in 1892, where in a footnote to page 233 he says he met with the phrase in Mill's 'Political Economy,' Mill himself crediting it to another writer, which other writer, though Spencer did not know it, was Auguste Comte. It thus happens that, notwithstanding his strenuous efforts to disclaim all influence of Comte, three of the leading terms of his philosophy, *social statics*, *sociology* and *altruism*, were Comtean terms.

After leaving the *Economist* he devoted himself for a time to article writing, which yielded him some revenue, though scarcely a livelihood, but which had the advantage of enabling him, as Nietzsche would say, to get rid of his thoughts. Instead, however, of getting rid of them, he found them taking complete possession of him. In fact, the very next year (1854) he commenced writing his 'Principles of Psychology,' which he finished within a year, and the work actually appeared in 1855. But even this, so far from satisfying him, served only the more completely to open up the vista of his future, and although he characterized the next two years as 'idle,' before the end of 1857 a great system of philosophy had taken shape in his mind. His first rough draft of its main heads was made and dated January 6, 1858. Two years later the complete prospectus was issued, and this was adhered to in most particulars during the subsequent thirty-seven years of its execution.

He had now made his plans known to all his friends and they had unanimously encouraged him to proceed. The great obstacle was publication, as no publisher would undertake so hazardous a work, and after much discussion and advice it was

decided to issue the work in parts by subscription. In one of the appendices to the 'Autobiography' appears the list of original subscribers. We may judge of the backing that he had, even at the outset, by the following names that are found among others in that list: John Stuart Mill, Charles Darwin, Thomas Huxley, Sir Charles Lyell, Sir Joseph Hooker, Sir John Herschel, Professor De Morgan, George Henry Lewes, George Eliot, Charles Kingsley, George Grote, Alexander Bain, Henry T. Buckle, Jules Simon.

It is interesting to compare the original draft with the final draft of the prospectus of Mr. Spencer's system. Aside from the difficulty of explaining why he called both parts of Vol. I. ('First Principles') the 'Unknowable' in the former, while Part II. in the latter deals with the 'Knowable,' there is the fact that in the original draft he makes Part III. treat of 'Astronomic Evolution' and Part IV. of 'Geologic Evolution,' these being the 'two volumes' that were wholly omitted in the completed system. As this original draft was never before published the world was left practically in the dark as to what these volumes would have contained had they been written. In the explanatory note inserted in the preface to 'First Principles' (p. xiv) he simply states that the application of these principles to inorganic nature is omitted, but this gives no intimation as to how this application would have been made. He does, indeed, refer in at least two other places to these omitted volumes ('Principles of Biology,' Vol. I., Appendix, pp. 479, 480; 'Principles of Sociology,' Vol. I., p. 3), and in the second of these he says that one of the volumes would have dealt with 'Astrogeny' and the other with 'Geogeny.' These appear to be the only hints that he gave out on this point, and few readers probably ever noticed them. But in one of his letters written in 1895 he entered much more fully into this subject and set forth clearly just what his whole system would have been had it been fully written out.*

The rest of the 'Autobiography' deals mainly with the execution of this great scheme, which need not be followed out. There are, however, many incidental matters connected with the chief matter, and some not connected with it, that have a special interest. Only a few of these can be mentioned. One of these relates to the reception that Mr. Spencer's books met with at the hands of the public. Nothing certainly is more annoying to a writer on philosophical subjects than the reviews of his books. As Spencer says, "adverse criticisms of utterly unjust kinds frequently pursue the conscientious writer. * * * Careless misstatements and gross misrepresentations continually exasperate him." He finally discovered that reviews do more harm than good. An author is lucky if no attention is paid to his books, for it is far better to be 'smothered with silence' than to be willfully or ignorantly misrepresented. A reviewer who has not the caliber to understand a book, but who must, nevertheless, review it because it is sent to the press, will usually indulge in cheap flings at it and apply to it damaging epithets calculated to deter readers from examining it. If it seems radical or opposed to current ideas it will arouse 'offended prejudices' or call down the *odium theologicum.* Everybody knows how Darwin's works were treated by the religious press. Then there is the subsidized press, which maintains a strict censorship over the contemporary literature, more effective in some respects than that of despotic governments, and every book that is suspected of being at all 'dangerous' is attacked by the leading journals, sometimes with ridicule, some-

* See Science, N. S., Vol. III., February 21, 1896, p. 294; 'Pure Sociology,' pp. 67–69.

times with apparent seriousness, usually by scholarly writers employed for the purpose. Even specialists can always be hired to write books down.

Mr. Spencer found that the sale of his books was being seriously interfered with through hostile reviews. Professor Bain, who was one of the subscribers, told John Stuart Mill that for a long time he did not read 'First Principles,' saying "that the impression gained from notices of it had deterred him. He went on to say that when, subsequently, he read the book he found to his astonishment that the reviews had not given him the remotest conception of its contents." It was, therefore, decided to send no more copies to the press, and this policy was adhered to until near the end of the work. After it had been fairly tested it was found on examining the accounts that the sales had about doubled.

As already remarked, Mr. Spencer was now beholden to no man and could devote all his energies to his great task. But he was destined to become a slave to a worse master than any superior officer. He was to become the victim of an insidious disease, a disease which proved incurable, and which attacked precisely the organ of which he had the greatest need—his brain. It began with insomnia, and was always attended with insomnia, but it soon threatened complete prostration, and from his thirty-fifth year to the end of his life it was one constant struggle for health. But it was not a fatal disease, as he lived well into his eighty-fourth year, and, as he says, it was not a painful disease, and, like most forms of neurasthenia, it did not show in his face, so that people always supposed him younger than he was. But it rendered continuous attention to anything whatever impossible. His work must henceforth be done at short sessions with long intervals of rest. There were sometimes days, weeks and even months that he could do nothing. In the pursuit of health he traveled much and resorted to all forms of amusement. Fishing was his favorite pastime, but he often took long pedestrian journeys.

He must have been a very poor observer. It would seem that he had subordinated and practically sacrificed his perceptive to his reflective faculties. With even the little dips into entomology, botany and geology that he had made in his early life, one would suppose that he would have seen more in the world. But he rarely mentions any object in natural history. It is very disappointing to read his account of walks, for example, round the Isle of Wight. He does, indeed, mention the chalk, but he never mentions the far more interesting Wealden formation, and seems to have had no idea of the geology of that island. It was the same with his visits to the Yorkshire coast and other places celebrated for their geological interest. But he observed men and human operations, and usually criticizes everything severely. Nothing in art, ancient or modern, came up to his ideal.

Herbert Spencer, as all know, never married, and it seems certain that his celibacy was the result of a reasoned resolve to let nothing interfere with his main purpose. But it is evident from reading his 'Autobiography' that he was not lacking in any of the qualities that would have made family life successful. He often alludes to it as a good that he was compelled to forego. His views of women were of the most enlightened kind, and the ideal of marriage that he sets forth in a letter to a friend about to marry is as perfect and noble as it is possible to conceive of. There are doubtless many readers for whom the most interesting part of his 'Autobiography' will be that which treats of his relations with George Eliot, although, so far as can be judged either from this work or from the 'Life and Letters of George

Eliot,' these relations were never in any sense sentimental. But they were certainly much more intimate and more prolonged than any of her letters would lead us to suppose. It is surprising to learn that it was he chiefly who urged her to write fiction, an idea which she could not at first entertain. The 'Letters' leave the impression that it was Lewes who played this rôle. Perhaps both equally saw in her this talent before she saw it in herself. It is equally surprising that she should have made Spencer her confidant in the matter of the authorship not only of her first stories, but also of 'Adam Bede.' It is to be regretted that she, too, did not write an autobiography.

Such is a hasty glance at a few of the salient points in the 'Autobiography' of Herbert Spencer. No two persons would select the same points, and no such glance can hope to do justice to the work. Nothing has been said of his inventions, which were numerous but none of them important or successful; of his numerous essays, from his 'Proper Sphere of Government' to his 'Factors of Organic Evolution'; of his 'Descriptive Sociology,' that monumental but costly undertaking; of his 'cerebral hygiene,' which, unlike that of Comte, consisted in reading nothing that he did not agree with, thus warping, as Comte had dwarfed, the growth of ideas; of his more extended travels, including his visit to America, which latter is familiar to us all; nor of his persistent hostility to governmental initiative (*laissez faire*), which formed so prominent a feature in his political philosophy.

With regard to this last it would seem that owing to preconceptions of his youth confirmed during his connection with the *Economist,* he was unduly frightened by the bugbear of collectivism, which is really nothing but social integration, and a necessary part of the very social evolution which he taught. For this must consist, as in both inorganic and organic nature, of differentiation and integration. His inability to perceive this made his system, so broad at its base, a frustum instead of a pyramid.

The 'Autobiography' is written in a much more pleasing style than his other works. It shows its author in all the simplicity of true greatness. His life demonstrates that he was a natural product of his time. He lived at the acme of the Victorian age, the grandest epoch in history, and he was directly in touch with all the powerful forces that characterized that epoch. When we take into consideration his own inherent powers we may say in very truth that his life was 'a continuous adjustment of internal relations to external relations,' and that he was a normal product of the laws of evolution that he expounded.

LESTER F. WARD.

WASHINGTON, D. C.

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## *THE WORK OF THE YEAR 1903 IN ECOLOGY.**

AN apology for this paper is necessary and will be forthcoming. The task outlined in the title is by no means voluntary, but has been imposed upon the speaker by your relentless committee; and this—as the secretary will acknowledge—in spite of the speaker's urgent protest. It is always impossible to give a critical summary of current events, because all of us are afflicted with the disease of contemporary blindness. It is more than impossible to do such a task for the field of ecology, since the field of ecology is chaos. Ecologists are not agreed even as to fundamental principles or motives; indeed, no one at this time, least of all the present speaker, is prepared to define or delimit ecology. It is, therefore, a

* Read by invitation of the sectional committee, Section G, American Association for the Advancement of Science, at the St. Louis meeting, December 29, 1903.

certainty that this hasty review will put emphasis where subordination or oblivion is better, and will notice slightly or not at all researches which will loom up in the future. Many titles which the speaker thinks important have been left out from lack of space and time.

If ecology has a place at all in modern biology, certainly one of its great tasks is to unravel the mysteries of adaptation. Are the many structures of animals and plants, which are obviously of use, fundamental or accidental in an evolutionary sense? The Darwinian and Lamarckian theories, which have almost totally replaced the gross teleology of former days, have usually been supposed to imply an evolutionary relation between an organ and its use. The Lamarckians have emphasized the direct response of organism to environment, and the inheritance of useful acquired characters. The Darwinians have emphasized the gradual 'working out' of highly useful structures by the influence of selection upon small fluctuating variations. The two theories are not necessarily inharmonious; the Lamarckians have inquired more as to the origin of variations, the Darwinians as to their survival. The publication of DeVries's mutation theory has occasioned a sharp change of front in many quarters. We hear more now than formerly of adaptation as a secondary thing; that it has little or no significance in an evolutionary sense. The idea that an organ is not explained when we assign it a function is not new; Geoffroy St. Hilaire made this one of the cardinal points of his evolutionary philosophy nearly a century ago, and we find the Greek philosophers debating the question in their day.

Professor Morgan's 'Evolution and Adaptation' has called the adaptation question once more to the fore. Morgan holds that the mutation theory accounts best for incipient organs, now useless, but eventually to become useful when fully developed, for organs that are wholly useless, and for 'over-adapted' organs (such as electric organs in fishes, leaf movements of *Desmodium gyrans*). Many organs that are useless or even harmful may survive because the organism may have some compensatory advantages making it as a whole well adapted. Another whose work tends to entice us from our former idols is Klebs, whose 'Willkürliche Entwicklungsänderungen' is certainly one of the great contributions of the year. Klebs is removed as far as possible from teleological ideas, and explicitly states that they have ruled so long because they are easy and restful ways of solving life's riddles. He holds that the polymorphism of a plant, like that of sulphur, is due to external agents, and that we should not ask for the purpose of the changes in one case more than in the other. The view just outlined is supported by facts from various sources; MacDougal has shown that etiolation is not, properly speaking, an adaptation to the dark; that plants are not to be looked upon as making efforts to reach the light. Étiolation is a response to certain factors, and may or may not be useful. Willis in his studies on the Podostemaceæ finds floral dorsiventrality, *i. e.*, zygomorphy, keeping pace in its development with increasing dorsiventrality in the vegetative organs. Zygomorphy here—so far from being an adaptation to insects—characterizes flowers that are in no sense entomophilous; the only entomophilous flowers of the group are the more primitive actinomorphic forms. If natural selection does not operate here, Willis asks, why may not other cases of zygomorphy be explained apart from insect visitation? Küster's 'Pathological Plant Anatomy' also helps to strengthen the chemico-physical view point of plant structures, in that he treats as alike the result of external agents, harmful struc-

tures, such as galls, and supposedly beneficial structures, such as aerenchyma of water plants, undifferentiated mesophyll of shade plants, etc. That all biologists are not going the way of Klebs and Morgan is evidenced by Francis Darwin's review of Klebs's book; Darwin holds that in the development of structures, adaptiveness must be taken into account, and that there is a difference between the organic and the inorganic. Verworn's biogen hypothesis and Driesch's neo-vitalism are expressions of a supposed difference between the living and non-living.

Nordhausen's experiments seem to support the Lamarckian theory, since he finds that the structural characters of shade leaves of the beech remain in large part in changed conditions. Thus useful characters, originally acquired through the agency of external factors, may be transmitted, at least in part, to later generations. On the other hand, the Lamarckian idea seems not to be supported by the work of Wiedersheim and Ball, who failed to confirm Hegler in the matter of securing an increased development of mechanical tissue in growing plants subjected to tension. Potonié has attempted to attack the problem from another side by a study of fossil plants; he claims that carboniferous plants were less perfectly adapted than those of to-day. This, however, is denied by Westermaier, who thinks that organisms must always have been as well adapted as they are now. Whatever the final outcome concerning this fundamental problem, whether the study of adaptation is scientific or unscientific, it is of value to recognize the presence of the problem; many have taken for granted on one side or the other what ought to be a subject for profound investigation.

Ganong in his splendid paper concerning the Bay of Fundy marshes has expressed another respect in which past study has been at fault, viz., in devoting paramount attention to structural rather than physiological characteristics of plants. We need to know not only about root hairs, leaf shapes and development of so-called protective structures; it is far more important to know a plant's physiological adaptation; its transpiration, its water-absorbing power, its physiological plasticity. From the hasty presentation here given it might be inferred that Lamarckians and Darwinians are necessarily regarded as believers in adaptiveness as a factor in evolution, and mutationists are necessarily supposed to hold the opposite view. This is, of course, incorrect, but it is certainly true that those who hold to mutation have laid the least stress upon the significance of adaptation. To the speaker it seems as if all three theories of evolution, and perhaps others yet unborn, are quite tenable, and that the problem of adaptation is not necessarily to be associated with any particular theory of evolution.

Not all will admit that experimental morphology is a part of ecology, but that its results are of the utmost importance in ecological interpretation can not be denied. The works of Klebs and Küster, to which allusion has been previously made, take a foremost place in this field, but in a summary of this character it will be impossible to specify details. Among the more interesting of recent experiments we may cite some which deal with the phenomena of symbiosis. Bernard's theory that tubers are essentially galls due to fungal attacks has been disputed by Laurent, who shows that concentrated solutions also induce tuberization. Bernard repeats and confirms the work of Laurent, and as a consequence broadens his view as follows: tuberization is induced by factors which cause a greater osmotic pressure within the cell. In nature fungi which penetrate the growing tissues form the chief means of

increasing the osmotic pressure. Bernard has also shown that beyond an early stage the germination of seeds of the orchids *Cattleya* and *Lœlia* is quite dependent upon the penetration of an endophytic fungus into the minute embryo. Aseptic cultures into which the fungus is introduced at once show vigorous growth. Thus, as Bernard states, the orchid seedling is dependent upon a fungus for its development, much as an egg is dependent upon fertilization. In this connection it may be noted that Pinoy succeeds in getting Myxomycete cultures only in the presence of bacteria, while Molliard finds that the development of perithecia in *Ascobolus* is highly favored by the presence of other fungi in the culture. The mycorhiza literature has received several additions during the year, but no marked advance has been made in our knowledge. Möller thinks that root fungi have little or no significance in the nutrition of green plants. Tubeuf, on the other hand, holds to the common view. Neger shows that the reason why autotrophic plants flourish better in sterilized soils is because of a change in the soil rather than in the absence of fungi, as Stahl supposed.

Among the important papers of the year we must, of course, include MacDougal's study of the influence of light upon the life of plants; his general conclusion that light does not directly influence growth is of great import in ecology, as is the view that light favors the differentiation of tissues. Eberhardt has now given us a detailed account of his studies concerning the influence of dry and moist air upon plant tissues, but there are few general results which he failed to outline in his preliminary notice. We may note Winkler's study of the causes of leaf position, in which Schwendener's pressure theory is opposed, though most of Winkler's papers, as well as the polemics which they occasioned, antedate the year now closing. The regeneration studies of Winkler, Goebel and several others have an ecological bearing but time will not permit their consideration. Bonnier has made some interesting morphological experiments on orchid roots, as has Benecke on the thalli and rhizoids of liverworts. Benecke finds that impurities in the glassware commonly employed in laboratories are responsible for some results, and in this connection we should note the work of Singer and Richter upon the influence of laboratory air in experimental cultures. These and other considerations demand that as much work as possible should be done out of doors, or at least in well-controlled greenhouses. From an ecological point of view much experimental work that is done in the laboratory or even in the greenhouse is of no direct value. Ganong, in his marsh paper, makes an appeal for field laboratories in connection with future ecological work, and it must be admitted that his argument is sound. The tropical laboratories and the recently installed desert laboratory are steps in the right direction, but even in these cases the experimental work which is to be of the greatest ecological value, must be performed not in the laboratories, but out of doors. In this, which the speaker believes to be the most promising line of ecological research, Bonnier has led the way in his magnificent experiments upon alpine plants. During the past year he has reported upon his parallel cultures at Paris and Toulon, in which portions of the same individual plant and identical soils are employed. He finds that his Toulon cultures from Paris plants are showing characters which the same species show in nature about Toulon, a result in harmony with his earlier alpine studies.

Among contributions based more on observation than experiment are: Paul on the biology of moss rhizoids, in which he maintains that they are primarily of value

as holdfasts; Kraemer on the epidermis, hypodermis and endodermis of angiosperm roots; Grimme on the flowering period of German mosses—a detailed and instructive paper; W. E. Britton on the anatomical features of the plants of the Connecticut sand plains; Bray's anatomical studies of desert plants; Parkin and Pearson on the anatomical characters of the plants of the Ceylon Patanas. These latter authors are surprised to find that the structures are as xerophytic in the wet as in the dry prairies, although it is nearly fifteen years since Schimper showed that xerophytes may be typical of certain wet habitats.

In ecological phytogeography the closing year has witnessed a considerable display of literature in America and England. Possibly no preceding year has afforded so many contributions. In our own country, one must give a prominent place to Ganong's paper on the Bay of Fundy marshes, a paper giving the results of the author's studies during several years in one of the most interesting physiographic areas in the world. As many of us know, Professor Ganong has postponed from year to year the publication of this paper, fearing lest errors might creep in that the study of just another season would rectify. Would that many another might heed his caution, and spare the world the undigested results of a week's ecological excursion! The completeness of detail and the accuracy of statement in Ganong's paper may well serve as models to working ecologists. Probably the harshest criticisms which his paper will receive are contained in his own concluding remarks. One of his suggestions, in addition to those already noted, may be mentioned here, viz., the necessity of finding a means of estimating quantitatively the biological factor, *i. e.*, the exact influence of competition and cooperation in determining the vegetation of a plant association. Another worker, and the only one who has so well exploited his particular field in America, is Bruce Fink, so long and so favorably known for his lichen studies; his recent development of lichen associations has added materially to our knowledge. The speaker has long felt that lichens are among the most interesting of plants ecologically, because they are so closely related to the unmodified physical environment. If any plants will show whether purely chemical factors are of influence in distribution, we should expect rock lichens to be of service in this regard. Apropos of this question of physics versus chemistry, one must mention the recent bulletin of Whitney and Cameron, in which the physical factor is given the dominant place. This view has been accepted readily by most ecologists, ever since Warming, following Thurmann and others, so clearly outlined the overwhelming importance as an ecological factor of the physics of the soil in relation to water. Other important American papers are: Livingston on the vegetation of Kent County, Michigan, presenting a model detailed map which represents a type of illustration too infrequent in American ecology; Transeau on the distribution of the bog societies of North America; Harshberger on the vegetation of mountainous North Carolina. In Britain the work of the lamented Robert Smith has been continued by his brother, who in cooperation with others has given two papers dealing with the vegetation of Yorkshire.

Several papers of more than ordinary interest from the view point of physiographic ecology, apart from Ganong's paper on the Bay of Fundy marshes, are as follows: Cajander's study of the alluvial vegetation of the Lena River, containing excellent analyses of phytogeographic terms as well as discussions on the genetic succession of associations; Penzig's study of the development of vegetation on Krakatoa since Treub's visit some years since; Häyren's

paper on the development of vegetation on the coast of Finland; Düggeli's detailed study of a Swiss valley about to be occupied by a reservoir, giving a basis for a study of the changes which will ensue; Weber's exhaustive study of the development of German moors; Huber's account of the encroachment of vegetation upon new islands in the Amazon. It is a pleasure to see such a list as this, probably the largest and best furnished by any single year to the study of association dynamics or physiographic ecology. While, as indicated above, the interpretation of ecological facts must be regarded as the ultimate end of ecological endeavor, the proximate end must largely be the collection of such facts. We deceive ourselves if we believe that this task has been more than fairly begun. Among the most important facts to be collated are those bearing upon the natural changes which the vegetation of a region undergoes. One may enter a field and make a guess as to what these changes are —this guess may or may not be intelligent; one can find each variety in literature—but the sole way to know what changes occur is to make detailed studies of limited areas year by year. In connection with ecological phytogeography one should mention also the admirable Vegetationsbilder issued by Karsten and Schenck, which serve to give photographic illustrations of distant and especially tropical landscapes. The studies of Engler in German East Africa and Cockayne in New Zealand should be included among the noteworthy contributions to knowledge. And it is, perhaps, in place to recall here the long-promised English translation of Schimper's 'Plant Geography,' which has so recently appeared.

Floristic phytogeography probably should not be classed under ecology, but there are many inter-relations between ecological and floristic aspects, which make a short survey of the field necessary. One of the remarkable contributions of the year is a volume by Hugo Bretzl on the botanical results of Alexander the Great's journey to the east, as reported by Theophrastus. As the speaker pointed out a year ago, too little attention has been paid to the phytogeographic contributions of Linnæus and other former workers. Bretzl's work shows that the Greeks observed and recorded a number of things for which but scanty credit has heretofore been given. The mangrove forests are described with great detail and accuracy; even the relation of various species to saltness is dwelt upon, and correctly. The Greeks were surprised to find conifers on the Himalayas and concluded that the vegetation of tropical mountains resembles that of European lowlands. Theophrastus gives the physiognomy of vegetation in terms of leaf forms; for doing this same thing only a century ago, most writers have given Humboldt the credit of founding phytogeography. Theophrastus anticipated many modern views in morphology and physiology, which of course have no place in this review. Beguinot has shown also that Porta, in his 'Phytognomonica,' published some centuries since, had a knowledge of many principles of distribution. One of the great floristic contributions of recent date is Jerosch's history and origin of the Swiss alpine flora, a volume which makes no pretensions of being more than a compilation, but which places in compact and trustworthy form the results of many workers. Other important floristic works are those of Alboff on Fuegia, R. L. Praeger on Ireland and Parrish on southern California. Among paleontological works bearing on distribution, perhaps the foremost place should be given to Flahault's volume on paleobotany in relation to present vegetation, a work of over two hundred pages and by a master hand. One must at least call by name Seward's presidential address before the

botanical section of the British Association on the geographic distribution of past floras, Wieland's novel but not new view as to the polar origin of life, and Schulz's papers on the geological development of the flora of the Saale and the Suabian Alps.

In closing, a word may be said as to the present status of Briquet's polytopic theory, a theory commonly discarded as untenable, but which the mutation theory and the growing belief in polyphylesis make more probable. The idea that a species may originate in more than one place, simultaneously or not, did not originate with Briquet, but he resuscitated it and christened it the polytopic theory. Though discarded by Jerosch and most writers, as unlikely if not unthinkable, Willis believes that the same step might be taken by species that are far apart, especially in similar conditions; indeed he thinks that this has actually happened within the Podostemaceæ. Arber has favored the idea of homeomorphy or parallelism of descent. Engler has admitted that varieties may originate more than once. It will be recalled that in DeVries's experiments the same species recurred many times, and that too from different parents. Blackman has found that about twenty per cent. of the arctic and antarctic algæ are identical as to species, but not found elsewhere. It will be conceded that in such a case the difficulties in the way of migration during the present or past ages are very great, while the polytopic theory seems to afford an easy explanation. Perhaps it is too easy; in any event it seems adapted for use as a last resort rather than as a general panacea. However, the researches of the past few years have placed the theory of polytopic origins in a position to demand the thoughtful consideration of all students of evolution.

HENRY CHANDLER COWLES.

## SCIENTIFIC BOOKS.

*Desert Botanical Laboratory of the Carnegie Institution.* By FREDERICK V. COVILLE and DANIEL TREMBLY MACDOUGAL. Published by the Carnegie Institution. Washington, November, 1903. Pp. 58, with 29 plates and 4 charts.

This attractive account of a botanical reconnoissance of the desert areas of the southwest will, without doubt, awaken great interest in desert vegetation, and stimulate the thorough investigation of the adaptations of xerophytes. The debt which ecology owes to Drs. Coville and MacDougal for fostering the idea of a desert laboratory, and for carrying it to a successful conclusion must become more and more apparent as the work progresses. The report deals in a very interesting though necessarily general fashion with the vegetation of the areas visited in connection with the location of the laboratory. These were: (1) The arid region of western Texas; (2) the sand dunes of Chihuahua; (3) the White Sands of the Tularosa Desert; (4) the vicinity of Tucson; (5) the gulf region about Torres and Guaymas; (6) the Colorado Desert; (7) the Mohave Desert; (8) the Grand Canyon of the Colorado.

In many ways the most interesting region to the ecologist is that of the White Sands of the Tularosa Desert. These are for the most part mobile dunes, composed entirely of gypsum; they cover nearly four hundred square miles. The soil is necessarily alkaline, a fact clearly indicated also by the abundance of *Atriplex* and *Suæda*. The characteristic vegetation of the dunes consists of woody plants, chief of which are *Rhus trilobata, Atriplex canescens, Chrysothamnus* and *Yucca radiosa. Yucca,* by virtue of its striking ability to push up through a sand cover, is a typical dune former. The White Sands when critically investigated should add an interesting chapter to the developmental history of dunes. The selection of Tucson for a laboratory site was based upon the variety and distinctness of its desert flora, as well as upon its being both habitable and accessible. The vegetation in the neighborhood of Tucson consists mostly

of *Covillea, Prosopis, Acacia, Opuntia, Echinocactus, Cereus, Parkinsonia,* etc. The presence of the Santa Catalina range, which rises to 6,000 feet, adds a mountain element to the vegetation. A further advantage of great importance lies in the central location of the laboratory with reference to the deserts of Texas, Mexico and California.

The general physical features of deserts are discussed in a caption filled with valuable meteorological and soil data. In connection with the latter, it is pointed out that lack of water is the fundamental cause of deserts, and that areas in which the water content is largely non-available are deserts as well as those in which the water content is low. The current conceptions of deserts are shown to be wholly inaccurate, particularly with respect to vegetation. Two great desert regions, called the Sonora-Nevada and the Chihuahua desert, are recognized by the authors. The former corresponds to the Great Basin region and the dry coast lands of northwestern Mexico; the latter extends northward from Chihuahua through parts of Arizona, New Mexico and Texas to the Bad Lands of South Dakota and the Red Desert of Wyoming. The annual rainfall in the most intense areas is less than 3 inches; in the least intense, 14–16 inches. Maximum temperatures of 110°–120° F. are frequent during the summer. The relative humidity is very low, the minimum frequently falling below 15°. The critical investigation of the physical factors, especially the water content, of these deserts is an alluring field for future workers at the Desert Laboratory.

Dr. MacDougal contributes a series of instructive experiments upon the transpiration of certain xerophytes of the region with relation to temperature, and makes an illuminating comparison of the results with those obtained from mesophytes. The xerophyte, in spite of its great insolation and the low humidity, loses water less rapidly than the mesophyte. The report closes with a valuable bibliography of desert vegetation, and of the climate, soil and water of deserts, which has been prepared by Dr. Cannon. It can not be too highly praised for the beauty of the plates, which have a much greater value for the understanding of the text than is at present the fashion in ecology.

Frederic E. Clements.
University of Nebraska.

*International Catalogue of Scientific Literature.* First Annual Issue—Q—Physiology. Including Experimental Psychology, Pharmacology and Experimental Pathology. Part I., pp. xiv + 404, 1902. Part II., pp. xii + 664, 1903. London, Harrison & Sons.

Physiologists will heartily welcome this long-expected catalogue. The first volume, which has recently appeared after some delay, is devoted to the literature of 1901 (a fact which should be, but is not, mentioned on the title page), and includes 1,094 pages of text and the surprisingly large number of 6,010 titles. Owing to the difficulties of organizing the work of the regional bureaus in the time at hand, it is issued in two separate parts; but it is intended that in the future only a single unbroken volume in each year shall be published. Each part of the present volume opens with a preface and instructions to the reader, both in the English language only. It would enhance their value if the instructions were printed also in French, German and Italian. There follow in order a schedule of classification and an index of the subject-matter of the science, which are repeated in each of the above four languages; then an authors' catalogue and a subject catalogue; and, lastly, a list of journals.

The scheme of classification of subject-matter is practically that which was submitted for criticism five years ago, though a considerable number of new subjects are introduced, and the order in some cases is changed for the better. It is to be regretted that one defect, earlier pointed out, was not remedied, namely, the introduction of a group to include general physiological phenomena, such as physiological division of labor, irritability, summation of stimuli, rhythm, specific energy, automaticity, fatigue, etc. If a reader wishes to learn what has been written on these subjects during the year, he finds it possible only by going through practically the whole scheme of classification. Rhythm and fatigue are found entered in the

index, it is true, but in a misleading way, for when one turns from them in the index to the corresponding numbers in the scheme of classification one finds 'rhythm' entered under 'hearing' and 'fatigue' under 'sense of movement.' Certain other subjects within the sphere of modern general physiology are not sufficiently elaborated. For example, all the tactic irritabilities, the literature of which is already large and constantly increasing, are grouped under one entry—'0150 Influence of Environment (Chemotaxis, Galvanotaxis, etc., High Altitudes, etc.)'—and are not mentioned specifically in the index. 'Secretion' as a general physiological phenomenon occurs nowhere, and there is no entry for 'internal secretion.' Some of the defects here mentioned are due to the fact that the basis of the scheme of classification is essentially morphological. The physiological literature of a particular organ can readily be found: not so readily the literature of a particular physiological principle. Though excellent in its details, the scheme of classification is too short-sighted. It is not yet too late to remedy this great defect. Let the numbering of the general groups, 'Physiology of the Organism as a Whole, 01,' and 'Physiology of the Cell and of Unicellular Organisms, 02,' be changed to '02' and '03' respectively; then let there be inserted a new group numbered '01' and entitled 'General Physiological Phenomena.' This group, properly elaborated, would contain at least many of the general subjects referred to and would facilitate the introduction of very valuable cross references. In future volumes this change, or an equally appropriate one, ought to be made, if the catalogue is to fulfill its high purpose.

The actual work of cataloguing seems to be well done. The cross references are numerous, both within the present volume and to volumes of the catalogue devoted to other sciences. There is a surprisingly small number of typographical errors. The typography is clear and of sufficient variety to facilitate the search for data. There is a natural curiosity on the part of the reader to know how near the list of titles approximates to completeness. A search within its pages for the articles published during 1901 in five representative journals of different countries, shows the following percentages of omissions: *Journal de Physiologie et de Pathologie générale,* 1 per cent.; [English] *Journal of Physiology,* 2 per cent.; *Archives Italiennes de Biologie,* 3 per cent.; *Pflüger's Archiv für die gesammte Physiologie,* 24 per cent.; *American Journal of Physiology,* 48 per cent. Our own country thus compares most unfavorably with those of Europe. Not only, however, are the contents of the American journals incompletely catalogued, but the list of our journals is incomplete, comprising in the present volume only nineteen in number, and omitting such well-known periodicals as the *Journal of Comparative Neurology and Psychology,* the *Journal of Medical Research* and the *Psychological Review.* Since each regional bureau is responsible for the literature of its own country, a critic is at first tempted to lay these faults at the door of the Smithsonian Institution. Their real cause, however, must be sought further back. Although duly and repeatedly petitioned for assistance, our government, unlike those of many of the European countries, has given no support to the work of our regional bureau; the expense has been assumed gratuitously by the Smithsonian Institution, which, however, has been greatly embarrassed by lack of funds. It is gratifying to know that this institution has recently been enabled to make more extended provision for the work. This will allow the deficiencies of the present volume to be made up subsequently, and will insure greater thoroughness in the future. Professor Langley invites any suggestions which will lead to the improvement of the catalogue. It is to be hoped especially that American physiologists will call his attention to such additional journals as publish either frequently, or even rarely, articles on physiological topics. In doing this it should be borne in mind that the physiology of the catalogue includes physiological chemistry, pharmacology, experimental psychology and experimental pathology. The literature of bacteriology is catalogued in a separate volume.

Americans can helpfully cooperate in still another manner, namely, by subscribing for

the catalogue. The cost of the annual volume on physiology is $9.20. Many physiologists will probably wish also the volume on general biology, the annual price of which is $2.45. The Smithsonian Institution acts as the representative of the central bureau in the United States, and receives subscriptions.

The International Catalogue is the one catalogue of scientific literature whose permanence can be relied upon. Its first issue is full of promise. Its ultimate completeness will be hastened by the cordial cooperation of those whose labors it is intended to lighten.

Frederic S. Lee.

Columbia University.

## SOCIETIES AND ACADEMIES.

### THE WASHINGTON MEETING OF THE AMERICAN PHYSICAL SOCIETY.

The spring meeting of the American Physical Society was held at Washington, D. C., April 22 and 23, at the invitation of the Washington Philosophical Society. Two sessions for the reading of papers and an evening lecture by Dr. Alexander Graham Bell on his famous tetrahedron kites were all held at the rooms of the Cosmos Club. These and other courtesies of the Cosmos Club were much appreciated by the society.

On Friday evening a considerable number of members of the society dined together at the Hotel Barton, and on Saturday, at the close of the morning session, the Philosophical Society entertained all members of the Physical Society who had been attending the session at luncheon at the same hotel. In the afternoon a visit was made to the new buildings of the Bureau of Standards, which are located near Connecticut Avenue in the northwestern suburbs of the city, about four miles from the White House.

There was a good attendance at the meeting and an unusually full list of papers was presented. All the papers in the following list were presented by the author or authors, excepting those by S. J. Barnett and A. A. Bacon, the authors being absent, and E. B. Rosa and M. G. Lloyd, because the hour for luncheon had arrived.

K. E. Guthe: 'A Study of the Silver Voltameter.'

P. G. Nutting: 'Some new Rectifying Effects in Conducting Gases.'

E. L. Nichols and Ernest Merritt: 'The Effect of Light on the Absorption and Electrical Conductivity of Fluorescent Liquids.'

F. A. Saunders: 'Some Additions to the Arc Spectra of the Alkali Metals.'

W. F. Magie: 'The Volumes of Solutions.'

G. W. Patterson: 'Absolute Electrodynamometers.'

E. P. Adams: 'Induced Radioactivity due to Radium.'

S. J. Barnett: 'The Energy Density, the Tension, and the Pressure in a Magnetic Field.' (Read by title.)

L. A. Fischer: 'A Recomparison of the U. S. Prototype Meter at the International Bureau of Weights and Measures.'

C. W. Waidner and G. K. Burgess: (*a*) 'High Temperature Measurement by means of Optical Pyrometers.' (*b*) 'Note on Special Problems in Optical Pyrometry.'

C. W. Waidner and H. C. Dickinson: 'Apparatus for Platinum Resistance Thermometry.'

C. W. Waidner and H. C. Dickinson: 'Intercomparison of Primary Standard Mercurial Thermometers.'

F. A. Wolff: 'The Standard Cell.'

F. A. Wolff: 'The Peculiar Behavior of Some Resistance Standards and Its Explanation.'

F. A. Wolff: 'A Direct Reading Apparatus for the Calibration of Resistance Boxes.'

E. B. Rosa and F. W. Grover: 'Absolute Measurement of Capacity.'

E. B. Rosa and F. W. Grover: 'Absolute Measurement of Inductance.'

E. B. Rosa and F. W. Grover: 'The Testing of Mica Condensers.'

E. B. Rosa and M. G. Lloyd: 'Testing of Alternating-Current Instruments.' (Read by title.)

A. A. Bacon: 'Equilibrium of Vapor Pressure over Curved Surfaces.' (Read by title.)

E. B. Rosa,
*Secretary pro tempore.*

### THE BOTANICAL SOCIETY OF AMERICA.

The annual report of the secretary embodied in Publication 24 is a statement of conditions and record of progress during the first decade of the existence of the society that must be highly satisfactory to its mem-

bers. The total constituency of the society now numbers 58, and its accrued funds amount to nearly three thousand dollars, a large part of which is treated as permanent endowment, the income only being used. Recently the policy has been adopted of making grants from current funds in aid of investigations by members and associates. Thus far the following awards have been made:

To Dr. Arthur Hollick, for the study of the fossil flora of the Atlantic coastal plain, $200.

To Dr. D. S. Johnson, for the study of the seeds and endosperm of the Piperaceæ and Chloranthaceæ, $200.

To Dr. J. C. Arthur for investigations on plant rusts, $90.

To Dr. C. J. Chamberlain, for the study of the spermatogenesis, oogenesis and fertilization of *Dioon* and *Ceratozamia*, $150.

To Professor F. E. Lloyd, for the study of certain types of desert vegetation to be carried on at the Desert Botanical Laboratory of the Carnegie Institution, $150.

To Dr. J. C. Arthur, for securing drawings of rusts, $50.

In order to promote unity of botanical interests a committee consisting of B. T. Galloway (chairman), C. R. Barnes and C. E. Bessey was appointed at the St. Louis meeting and requested to prepare a plan for coöperation with other botanical organizations, for consideration at the eleventh annual meeting.

The increasing demand upon the time allowed by the society for the presentation of scientific papers has made necessary the action of the council in accepting only papers from members, associates and persons specially invited to contribute by the council. The programs, almost without exception, are now made up from papers, the titles of which are sent to the secretary in advance of the meetings.

Among those who have recently presented papers before the society by special invitation are Professor K. Goebel, of Munich, Germany; Professor H. de Vries of Amsterdam, Holland; Professor T. H. Morgan, of Bryn Mawr, and Mr. Frances Darwin, of Cambridge, England.

The reprinted addresses of the past presidents are the only scientific publications issued by the society and may be taken as a fair index of the maturer investigations that have been prosecuted in America. The list includes the following titles:

PROFESSOR WILLIAM TRELEASE: 'Botanical Opportunity.'

PROFESSOR CHARLES E. BESSEY: 'The Phylogeny and Taxonomy of Angiosperms.'

PROFESSOR JOHN M. COULTER: 'Origin of Gymnosperms and the Seed Habit.'

PROFESSOR L. M. UNDERWOOD: 'The Last Quarter; The Reminiscence and an Outlook.'

PROFESSOR B. L. ROBINSON: 'The Problems and Possibilities of Systematic Botany.'

PROFESSOR J. C. ARTHUR: 'Problems in the Study of Plant-rusts.'

DR. B. T. GALLOWAY: 'What the Twentieth Century Demands of Botany.'

At the tenth annual meeting recently held in St. Louis the following associates were elected members:

Frederick Edward Clements, University of Nebraska.

Henry Chandler Cowles, University of Chicago.

William Ashbrook Kellerman, The Ohio State University.

Also the following associates were elected:

William Austin Cannon, Desert Botanical Laboratory, Tucson, Arizona.

Karl McKay Wiegand, Cornell University.

The officers for 1904 are:

*President*—Frederick Vernon Coville, U. S. Dept. of Agriculture, Washington, D. C.

*Vice-President*—Charles Edwin Bessey, The University of Nebraska, Lincoln, Nebraska.

*Treasurer*—Arthur Hollick, New York Botanical Garden, New York City.

*Secretary*—Daniel Trembly MacDougal, New York Botanical Garden, New York City.

*Councilors*—Benjamin Lincoln Robinson, Gray Herbarium, Harvard University, Cambridge, Mass., and John Merle Coulter, University of Chicago, Chicago, Ill.

The above officers, with Past President Charles Reid Barnes, constitute the council of the society.

D. T. MACDOUGAL,
*Secretary.*

THE NEW YORK ACADEMY OF SCIENCES.
SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

The regular meeting of the section was held on March 28 in conjunction with the New York Branch of the American Psychological Association. The afternoon session was held at the Psychological Laboratory of Columbia University, the evening session was held as usual at the American Museum of Natural History. The program was as follows:

*Mental Resemblance of Twins:* Professor E. L. Thorndike.

A report was made on the general results of a comparison of twins in tests of attention, perception, association, rate of movement, addition, multiplication and stature. The resemblances as measured, by a rough, preliminary method, were about .75. The amount of this resemblance that should be attributed to similarities in home training was apparently slight. There was no evidence in the results to support the theory that twins fall sharply into two species, those very closely alike and those no more alike than ordinary brothers and sisters.

*Measurements of the Mentally Deficient:* Miss Naomi Norsworthy.

The paper was a report of some work done among one hundred and fifty mentally deficient children in two state institutions for the feeble-minded and in two of the special classes organized in the New York schools. The measurements taken were physical, such as height, height and temperature, tests of maturity, as perception of weight and of form, tests of memory and tests of intelligence or the ability to deal with abstract ideas. The main conclusion reached was that the difference between idiots and people in general is less than has been commonly supposed, and is a matter of degree rather than of kind.

*Color Contrasts:* Dr. R. S. Woodworth.

Dr. Woodworth presented a modification of Hering's binocular demonstration of the 'physiological' origin of simultaneous contrast. If monocular fields of different colors, with a gray spot on each, be combined by the stereoscope, each gray retains the contrast color suitable to its own field, however the conscious background may vary as the result of fusion or rivalry of the two fields. The demonstration is readily extended to cover brightness contrast, by placing gray spots on white and black fields which are combined as before. To show that these effects are not the result of a binocular mixture of the gray with the opposite field, a number of gray spots may be scattered over one field, and the other field made particolored; the gray spots appear all alike, or nearly so, though binocular mixture would have made them differ.

*New Apparatus and Methods:* Professor J. McKeen Cattell.

(1) Kymographs were exhibited in which typewriting ribbons were applied to secure the records. Electro-magnetically moved points strike the paper tape, whose rate of movement may be adjusted, and a record is left by the slowly moving typewriter ribbon. Two forms were exhibited, in one of which the kymograph was driven by an electric motor and in the other by clock-work. In the latter the clockwork could be started and stopped by an electric current by an observer in another room. The kymographs, while not especially suited for drawing curves, are much more convenient than smoked paper or siphon pens for time records, such as rhythms, conflict of the visual fields, after-images, etc. (2) Instruments were shown by which a number of faint clicks could be given at intervals of a second for testing sharpness of hearing and defective hearing. Instead of giving the observer a continuous sound, such as from the ticking of a watch, two, three, four or five faint sounds are made, and the observer is asked how many he hears. By this method errors from the common illusion in the case of faint sounds are avoided. (3) A method was exhibited for testing color blindness by the time it takes to distinguish one color from another. By the normal individual red can be distinguished from green in about the same time as blue from yellow, but it takes longer to distinguish red from orange. If the observer belongs to the red-green class of the color blind, he can distinguish blue from yellow as quickly as others, but not red from green. An instrument was shown by which

the conditions of the railway service can be imitated, it here being necessary first to distinguish a certain color and then to make the proper movement.

*The Time of Perception as a Measure of Differences in Sensation:* V. A. C. Henmon.

The aim of the investigation upon which this paper is based is to measure qualitative differences in color by the time of perception. The colors taken as standards were red, orange and yellow, whose wave-lengths had been definitely determined. Equal intermediate steps between orange and red were produced by the mixture of pigments. Small squares of each of these colors, 3 x 3 cm., were mounted on cards side by side with red, and exposed to the subject by means of a drop-screen so arranged as to give almost instantaneous exposure. The subject reacts with the right or left hand according as the predetermined stimulus appears to the right or left. The registration is made with the Hipp chronoscope. The results of 6,000 reactions gave evidence of the validity of the method and the fruitfulness of the problem. Equal objective differences are correlated with differences for consciousness, showing a definite increase as the magnitude of difference is decreased.

*The Daily Curve for Efficiency:* Mr. H. D. Marsh.

*Habits Based on Analogy:* Professor Charles H. Judd.

*The Determination of the Habit Curve for Associations:* Professor J. E. Lough.

A report of experiments made in the psychological laboratory of the school of pedagogy. It was found that the time required to write series of letter-equivalents when the 'key' of equivalents was not memorized, but was consulted as frequently as necessary, diminished as the associations between the letter-equivalents became more habitual. The curves representing the results of these experiments exhibit all the characteristics of the typical habit curve. Repetition of the experiment using new 'keys' shows little or no interference due to earlier associations, while with each succeeding 'key' the physiological limit was reached after a constantly diminishing number of trials.

*A Neglected Point in Hume's Philosophy:* Dr. William P. Montague.

The paper aimed to show (1) that Hume (in Part IV., Section II. of the 'Treatise') had quite unwittingly furnished what from his own point of view should have been regarded as a logical deduction and justification —rather than the mere psychogenetic description, which it purported to be,—of the realistic belief in the independent and uninterrupted existence of sensible objects; and (2) that the *naïve realism* or positivism thus accidentally promulgated was from both the scientific and the popular standpoint, a far sounder and more inviting doctrine than the empirical idealism or sensationalism with which Hume's name is usually associated.

*Action as the Concept of Historical Synthesis:* Mr. Percy Hughes.

Rickert's description of the content of history as reality is amended to read *past reality*, the past of evidence. From this definition the individual, objective, moving and continuous character of historic content follows; and further, the conception of action as descriptive of both historic content and historic synthesis. An historical synthesis is a past action that itself has created a certain synthesis of evidence; which the historian discovers. In such synthetic actions, 'simple' actions retain their individuality as means, stimuli or hindrances to the main action, *i. e.*, in a functional relation.

At the close of the afternoon session the members were invited to attend a lecture given in Columbia University by Professor John Dewey on 'The Psychologist's Account of Knowledge.'

James E. Lough,
*Secretary.*

### SECTION OF GEOLOGY AND MINERALOGY.

The section held its regular meeting Monday evening, May 16, with the chairman, Professor James F. Kemp, presiding.

The following program was offered:

*Exhibition of the Series of Foot Bones Illustrating the Evolution of the Camel, Recently Installed in the Hall of Vertebrate Paleontology of the American Museum of Natural History:* W. D. Mathew.

This series corresponds to that illustrating the evolution of the horse, and is almost equally complete.

It shows the derivation of the camel from small primitive four-toed ancestors which are exclusively North American in habitat. The earliest known ancestors are tiny animals no larger than a rabbit. The camels reached their maximum size and abundance in the Pliocene epoch, when they were much larger than the modern camels. Then they spread to the other continents, disappeared entirely from North America, and became smaller in size and far less numerous in species elsewhere.

*Some Erosion Phenomena in St. Vincent and Martinique:* Edmund Otis Hovey.

In this paper the author showed lantern slides from some of the photographs taken by him in those islands in 1902 and 1903, for the American Museum of Natural History, which illustrated the development of new drainage systems and the reinstatement of old channels in regions which were most thickly covered with ejecta by the 1902 and 1903 eruptions of the Soufrière and Mont Pelé.

The principal paper of the evening was:

*Some of the Localities in France and England where Monuments of the Late Stone and Bronze Ages have been Found:* J. Howard Wilson.

In considering the subject of these stone monuments, the author confined himself to those found in northern France and southern England, and especially the great groups near Carnac in Morbihau, and the well-known temples of Stonehenge and Avebury, in Wiltshire.

The monuments were divided according to type into several classes, and a description of each of these given briefly with their comparative ages and the probable purposes for which they were constructed. Legends concerning these monuments were cited, and mention was made of the superstition and veneration with which they have been regarded by some of the more ignorant and conservative peasants, causing the worship of stone to be kept up to the present day in some remote districts.

Before closing the paper, attention was called to the engineering skill required in the placing and erection of some of the monuments and the early age at which it made its appearance.

The paper was followed by slides showing photographic views of some of the most famous monuments, maps and drawings of several of the curiously engraved stones.

Edmund Otis Hovey,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### THE COMPLEX NATURE OF THORIUM.

To the Editor of Science: The following appeared in *Nature,* April 28, p. 606:

#### THE COMPLEX NATURE OF THORIUM.

With regard to several letters on thorium and its complex nature that appeared in *Nature* of March 24 and 31, April 7 and 14, and in which my name is mentioned, I take the liberty of adding a few remarks, having had ten years' experience in working with thorium.

In 1897, at a meeting of the British Association in Toronto (Canada), I read a paper in which I pointed out that spectrum evidence proves the complex nature of thorium.

In 1898 (*Chem. Soc. Trans.*, p. 953) I isolated from some thorium fractions an earth with an atomic weight of 225.8 (tetrad). Knowing the difficulties of the separation of rare earths (I have been engaged in this kind of work since 1878), and not wishing to publish a premature conclusion, I did not declare this to be a novel constituent of thorium, but said that foreign earths were present, in spite of the fact that the reaction used ought to have separated them.

In 1901 I published another short paper (*Proc. Chem. Soc.*, March 21, 1901, pp. 67–68), in which I said that "my experiments may be regarded as proving the complex nature of thorium. Thorium was split up into the $Th^{\alpha}$ and $Th^{\beta}$. With $Th^{\beta}$ I obtained so low an atomic weight as $R^{iv} = 220$. The fractions $Th^{\alpha}$ gave by the analysis of the oxalate, though it was prepared by pouring the thorium salt solution into an excess of oxalic acid, in order to avoid the formation of

a basic salt, the high atomic weight $R^{iv}=236.3$. But I stated expressly, and I feel obliged to repeat it, that these fractions show a great tendency to form basic salts. Assuming these to be normal, a higher atomic weight than the true one is obtained. This is true especially in regard to the oxalate.

The splitting up of thorium into $Th^{\alpha}$ and $Th^{\beta}$ was, of course, not so sensational an event as the announcement from America of the splitting up of thorium into 'carolinium' and 'berzelium.'

BOHUSLAV BRAUNER.

Bohemian University, Prague,
April 18.

Those who have read my work and heard my recent paper delivered before the Washington, New York and North Carolina sections of the American Chemical Society do not require further information regarding the above. In view of the fact that many British men of science are not familiar with the work and may be misled, it has been deemed wise to despatch the following to the editor of *Nature*.

*Re Thorium.*—The elementary nature of thorium has been questioned by several workers, namely, Chroustschoff in 1889 (*J. russ. phys. Chem. Ges.*, 29, 206), Rutherford in 1899 (*Phil. Mag.*, 49, 2, 1900), Crookes in 1900 (*Proc. Roy. Soc.*, 66, 406) and in 1901 Brauner (*Proc. Chem. Soc.*, 17, 67) and Baskerville working independently (*Journ. Am. Chem. Soc.*, 23, 761). The methods employed were different in each case.

The undersigned has made no claim of priority as to the idea of the complexity of thorium, but he distinctly claims to have applied novel methods and an old one, which demonstrate to the satisfaction of himself and others familiar with the work, not only the complexity of old thorium, but the existence of two new elements to which the names of carolinium and berzelium have properly been given. The old method was used by Berzelius, who died thirty years before the plaintiff, according to his own statement (April 28, p. 606), began his work on the separation of the rare earths.

Scientific men will await the appearance of the paper, which will be published shortly in the *Journal of the American Chemical Society*, and see that all workers have received full credit for their share in the solution of the question. In the meantime, the letter adverted to, carrying much that is true and a distortion, which any one may verify by reference to the literature, to say the least is in poor taste.

For fear lest the old proverb, '*qui tacet consentire videtur,*' carry too much influence, the above statement is reluctantly made.

CHAS. BASKERVILLE.

UNIVERSITY OF NORTH CAROLINA, U. S. A.,
May 17, 1904.

### A REDDISH-BROWN SNOWFALL.

TO THE EDITOR OF SCIENCE: An incident which should, perhaps, be recorded is that of a reddish-brown snowfall which occurred at this place on February 2 last (1904). A light snow was falling on that day and about noon the character of the snow-fall changed to a reddish-brown or light chocolate color. This continued for half or three quarters of an hour, after which the snow-fall of ordinary appearance continued during the afternoon, the colored snow appearing as a well-defined layer between the white snow which fell before and after it. An examination under the microscope showed numerous irregular-shaped, semi-transparent particles with an appearance similar to feldspar. Nitric and muriatic acid applied to them gave no apparent result. Examined microscopically during the snow-fall it appeared that the particles were not carried on the snow, but were embedded in the snow crystals. Other ordinary contaminations were present, but were plainly distinguishable from the peculiar particles in the snow crystals. The phenomenon was observed in two or three near-by towns, but, so far as learned, not outside this immediate vicinity.

EDWARD LINDSEY.

WARREN, PA.,

## SPECIAL ARTICLES.

### MENTAL EFFICIENCY AND HEALTH.

IN the address as president of the American Society of Naturalists, read by Professor Cattell at the annual dinner, January 1, 1903, and printed in this journal, April 10, 1903, is inserted a table giving the grades for different

mental traits assigned by twelve independent judges to five American men of science.

Though these individuals are merely cited from a list of thousands in illustration of the methods employed in collecting data for the study of mental characters, the figures given in the table have an apparent bearing upon the question of the relation which exists between the quality and efficiency of a man's mental activity and his constitutional physical health. I should like to call attention to certain facts deducible from the table, and to express the hope that in preparing the results of the study for publication this aspect of the problem may not be overlooked.

Of the five persons graded one ranks very high in physical health, one is decidedly low, one falls close to the indifference line of the series, and the other two lie at points considerably above and below this mean. The range of physical variations is thus wide enough to enable one to observe clearly any mental and physical correlations which exist.

A glance at any one of the following sets of figures into which the table given on page 568 has been distributed, will show at once that certain marked features of correlation appear, but that the mental grading does not parallel throughout the variations in physical health. As regards individuals, *D* is so consistently divergent as to belong to a separate group from the other four, who present a fairly well-marked series of correlations. The grades of health in the five men, from which comparison proceeds, together with the average ranking of each in the whole series of mental traits are given in the following table:

| Men. | *D* | *A* | *B* | *C* | *E* |
|---|---|---|---|---|---|
| Health, | 90 | 63 | 55 | 26 | 12 |
| Traits, | 43.6 | 77.6 | 56.4 | 46.9 | 24.1 |

The grades, it will be recalled, are on a scale of 100. The letters indicating individuals in the original article are retained in the present tables. With the exception of *D* the estimation of general efficiency in the members of the group rises and falls with the condition of physical health. As these figures are the representatives of a set of curves which are not all consistent, I have distributed the twenty-three traits in several groups into which they seemed naturally to fall, and which may be described as follows: Mental range and balance, intellectual capacity, emotional sensibility, energy of will and social adaptiveness. The special traits included under these several heads are mentioned in connection with each set of figures.

| Men. | *D* | *A* | *B* | *C* | *E* |
|---|---|---|---|---|---|
| Mental balance, | 45 | 84 | 79 | 32 | 20 |
| Judgment, | 30 | 96 | 70 | 30 | 15 |
| Breadth, | 63 | 93 | 74 | 38 | 68 |
| Efficiency, | 34 | 100 | 57 | 74 | 4 |
| Average, | 43 | 93 | 70 | 43 | 27 |

I have included efficiency in this table because, as used in the paper, it seemed to have more affiliation here than with energy of will. It will be noted that the table presents only one individual divergence from the curve of health. The series grouped under intellectual capacity follows:

| Men. | *D* | *A* | *B* | *C* | *E* |
|---|---|---|---|---|---|
| Intellect, | 38 | 90 | 57 | 79 | 49 |
| Quickness, | 9 | 87 | 57 | 99 | 33 |
| Intensity, | 57 | 82 | 25 | 76 | 8 |
| Originality, | 66 | 82 | 17 | 84 | 8 |
| Clearness, | 17 | 90 | 74 | 72 | 45 |
| Average, | 37 | 86 | 46 | 82 | 29 |

The correlation in this group is less extensive than in the preceding. The same individuals stand at the top and bottom of the list—a pronounced condition of bodily weakness lowers efficiency here as elsewhere—but the series presents much greater individual irregularities. The following traits have been grouped under energy of will:

| Men. | *D* | *A* | *B* | *C* | *E* |
|---|---|---|---|---|---|
| Will, | 63 | 90 | 45 | 49 | 2 |
| Energy, | 77 | 98 | 32 | 90 | 3 |
| Perseverance, | 87 | 96 | 30 | 54 | 1 |
| Independence, | 52 | 94 | 57 | 72 | 5 |
| Courage, | 45 | 95 | 52 | 51 | 12 |
| Leadership, | 6 | 87 | 20 | 17 | 6 |
| Average, | 55 | 93 | 39 | 56 | 5 |

In this group of traits the extremes of efficiency are greatest and the falling off which accompanies constitutional weakness most marked. In the lowest of the group it is almost a negligible quantity. *D*'s grade

attains its maximum in this set of will-traits, as we should perhaps expect, yet his physical health suffices only to pull him to the middle of the group. The relatively high attainment of *C*, who is graded 26 in the indices of health, is to be noted. Only two traits seemed to fall naturally into the following group:

| Men. | *D* | *A* | *B* | *C* | *E* |
|---|---|---|---|---|---|
| Emotion, | 26 | 13 | 26 | 24 | 55 |
| Refinement, | 4 | 52 | 72 | 8 | 63 |
| Average, | 15 | 32 | 49 | 16 | 59 |

The curve presented here differs strikingly from all which preceded it. It is practically an inversion of the type. With the exception of *C*, in whom mental endowment and moral force have already been found in excess of physical vigor, this reciprocal correlation forms a continuous curve. The remaining traits concern various aspects of social adaptability, and have been grouped under a single head:

| Men. | *D* | *A* | *B* | *C* | *E* |
|---|---|---|---|---|---|
| Reasonableness, | 38 | 67 | 93 | 20 | 20 |
| Cooperativeness, | 38 | 63 | 49 | 19 | 10 |
| Unselfishness, | 45 | 38 | 67 | 10 | 17 |
| Kindliness, | 54 | 45 | 82 | 10 | 48 |
| Cheerfulness, | 34 | 48 | 77 | 34 | 26 |
| Integrity, | 76 | 96 | 87 | 38 | 38 |
| Average, | 47 | 59 | 76 | 22 | 26 |

For the first time in the series the maximum is removed downward to the middle of the group. The decline in adaptiveness—social virtues, in other words—is most pronounced in connection with conditions of poor health, but the falling off is important in the other direction also.

As to the significance of these curves, the material is of course altogether inadequate to justify general conclusions, but it is a very interesting fact that the correlation which every one in a way believes in, but would, perhaps, expect to be discernible only in large masses, is presented not only in general, but with characteristic variations even in this small group of individuals chosen at haphazard. If I may assume these five cases as the basis for comments to serve as suggestions for consideration in connection with larger mass of data, the following facts may be noted: Having regard to the main group of four, breadth and sanity of mind, together with executive ability, vary directly with conditions of physical health; but the distribution of original mental endowment, quickness and clearness of grasp, appears independently of its variations. Of all the traits here enumerated the virtues of will—energy, courage, capacity for leadership—fall off most rapidly with extreme degrees of physical weakness; but the efficiency of the individual can not be predicted in the middle ranges of health. The curve of social adaptability reached its maximum in the middle of the group. Reasonableness, unselfishness and the like are apparently not the virtues of the strong; as they are likewise not the marks of a frail or nervously unstable constitution, for which all complex human relations become irksome. If the induction were not based upon so fragmentary a series of observations, one might look upon this curve as indicating the ultimate dependence of sympathy and social integrity upon physical conditions which give rise to a sense of the need of aid, and that these instincts show a decline of intensity in those of rugged strength.

The curve of emotional sensibility and refinement rises with delicacy of constitution, its maximum appearing in the weakest, its minimum in the most robust, member of the group. In connection with this point it may be worth while to observe whether the approach to perfection of physical health is in general—as here—characterized by a more or less marked decline, instead of a continuous rise in general mental efficiency. Without going so far as W. D. Howells, who, in commenting upon Gould's 'Biographic Clinics,' suggests that the ill-health of Carlyle, De-Quincey, Huxley and others might, perhaps, be considered an important factor in their intellectual productiveness, it may well be questioned whether a man is not handicapped rather than favored in regard to mental efficiency by being a perfectly healthy animal. The former functions depend in a peculiar sense upon the development and activeness of the nervous system, the latter upon digestional integrity and adequate nutrition of the muscu-

lar tissues. Mental capacity and vigor may depend upon an upsetting of the physiological balance and the aggrandizement of the central nervous system at the expense of these other processes. Great prosperity in the vegetative functions—which we call physical health—would thus be inimical to the highest intellectual enterprise, and the case of *D* would be made characteristic instead of anomalous. It is at least suggestive that the eupeptic maximum in adults is found in connection with the first stages of general paralysis.

The gist of the figures contained in the table, theorizing apart, is sufficiently indicative of the importance of physical vigor as a condition of mental activity to make the matter worthy of consideration in future study.

Robert MacDougall.
New York University.

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## *THE ELECTRON THEORY.*

Professor J. J. Thomson in the March number of the *Philosophical Magazine* discusses the theory of the stability of systems of electrons. His conclusion is that a number of electrons constitute a stable system when they are grouped in a series of concentric circular rings, very similar to Saturn's rings, which rotate about a common axis. Stability depends upon two conditions, namely, (*a*) upon a certain minimum angular velocity of rotation of a ring, and (*b*) upon the presence of at least $f(n)$ electrons at or near the center of a ring containing $n$ electrons. Stability increases when the angular velocity increases above the critical value and when the number of internal particles is greater than $f(n)$; $f(n)$ being a definite function of $n$.

The first part of Professor Thomson's paper is devoted to the establishment of the two conditions of stability (*a*) and (*b*) and the second part of the paper is devoted to the application of these results to the theory of the constitution of the atom. The features of the second part are:

1. A brief discussion of the types of oscillation of systems of electrons and the application of these results to the rationalization of spectra. Professor Thomson goes no farther than to show in a general way that the spectral lines of a given element may be grouped in a number of series of related lines, and that the different chemical elements of a group or family, such as the alkali metals, may have closely related series of lines. This same idea has been advanced by H. Nagaoka, of Tokyo, who promises soon to publish a paper devoted to this method of classifying spectra.

2. A full discussion of the relations between stable systems containing greater and greater numbers of electrons, and the application of these results to the rationalization of Mendeléef's periodic law. In this section of the paper Professor Thomson shows that a system of electrons furnishes a dynamic model which, with increasing numbers of electrons, exhibits properties closely analogous to those remarkable periodic variations of valency of the chemical elements with increasing atomic weight. This constitutes the first suggestion of anything worthy to be called a rational basis of Mendeléef's law, and its importance can scarcely be overestimated. It is, perhaps, the greatest contribution to theoretical physics during a decade. In this section of his paper Professor Thomson discusses the process of chemical combination in terms of his theory and he suggests an explanation of the catalytic action of water and of a metal such as platinum.

3. An application of the fact that the stability of a system of electrons depends upon a certain minimum angular velocity of the electron rings, to the explanation of radioactivity.

It is the purpose of this note merely to call attention to Professor Thomson's paper, which should be carefully read by every student of chemistry, and to give to the reader a sufficiently clear idea of the electron to enable him to fully appreciate Professor Thomson's theory of the structure of the atom.

It is not to be expected, of course, that a new hypothesis should lead at once to anything approaching a completely consistent theory and it may be helpful to readers of Professor Thomson's article to point out the weak points of his theory.

The electron itself, although it has some very definite claims to objective existence, is not an entirely clear idea. The electric stress which radiates from an electron can, indeed, be thought of in mechanical terms, and the manner in which these lines of stress sweep through space when the electron moves, and the way in which they build up a magnetic field by their motion, can be thought of in a precise way, but no one has at present any definite idea of the nucleus of an electron nor of the way in which the nucleus moves. The mechanical analogue outlined below is misleading in this respect in being free from some of the essential difficulties which arise in the electrical case.

Professor Thomson's explanation of zero valency (which is exhibited by such elements as helium, neon, argon, etc.) does not appear quite satisfactory. He represents zero valency as an extremely evanescent and unstable case of monovalency.

I fail to see how, in Professor Thomson's theory, to explain the rise of valency of a given element by twos, for example the rise of valency of nitrogen from 1 to 3 to 5. This mode of rise of valency has suggested to chemists the idea of the neutralization of valency bonds by each other in pairs. However, this difficulty may be met, perhaps, by using the notion of subsidiary groups of electrons.

On the other hand, Professor Thomson's hypothesis, that the atom consists of a number of extremely minute negative electrons moving about in a small spherical region containing uniformly distributed positive charge, meets a fundamental difficulty, namely, that experiment has hitherto failed to give any evidence of the existence of concentrated positive charges corresponding to the excessively concentrated negative charges which constitute cathode rays. In conformity with this hypothesis as to the structure of the atom, the mass of an atom is to be taken as proportional to the number of negative electrons the atom contains, regardless of the extent and value of the distributed positive charge. This is explained later in mechanical terms.

A clear idea of the behavior of a system of electrons depends upon an understanding of the dynamics of a single electron, and the dynamics of an electron is very different from the dynamics of a material particle.

The dynamics of an electron depend primarily upon the fact that kinetic energy is associated with a moving electric charge independently of the 'material' mass of the body upon which the charge resides. That is to say, electric charge has inertia or mass. This association of kinetic energy with an electric charge is a phenomenon of the electric field, not of the charge itself and the mode of association is precisely (not necessarily accurately) understood. Stated in terms of a mechanical analogue, it is as follows: Imagine a great lake of jelly with a mass-less cylinder pressed down upon its surface. Underneath the cylinder the jelly will be under stress and strain and this stress and strain will represent energy, corresponding to the purely electrical energy associated with the electrical stress surrounding a charged body. If this mass-less cylinder be rolled along over the jelly surface the strain figure underneath the cylinder will travel with the cylinder, and each successive portion of the jelly will move as it is twisted into conformity with the approaching strain figure and as it is again twisted into its unstrained condition after the strain figure is passed. *This motion represents kinetic energy corresponding to the magnetic energy of a moving electron, and the strain figure, therefore, has inertia.*

If the cylinder is small in diameter the strain which is associated with it is greatly concentrated and for a given integral amount of stress or strain (given force pushing the cylinder down) a much greater amount of kinetic energy would be associated with a given velocity of the rolling cylinder, inasmuch as the successive portions of the jelly would move with increased velocity as they are twisted into conformity with the approaching strain figure, and as they are again twisted into an unstrained condition after the strain figure has passed. Therefore, a strain figure having a given integral amount of strain has greater and greater inertia the more the strain figure is concentrated. At

velocities which are low as compared with the velocity of wave propagation on the jelly surface the kinetic energy of the moving strain-figure is proportional to the square of its velocity and, therefore, its inertia or mass value is constant. Where the velocity of the strain figure is not very small then the inertia reaction of the moving particles of jelly as they are twisted into and out of the moving strain figure *helps to sustain or hold the strain of the moving figure.* Thus at full wave velocity a strain figure is held wholly by this inertia reaction and no cylinder need be pressed upon the jelly to maintain a strain figure. On the other hand, when the cylinder is pushed down with given force the integral stress increases more and more with increasing velocity, a portion of the stress being sustained by the cylinder and a portion being sustained by the inertia reactions above mentioned. Therefore, with given force on the cylinder the integral stress approaches infinity as the velocity of the cylinder approaches the wave velocity, and corresponding to this increase of integral stress due to given force on cylinder the inertia or mass value of the strain figure increases indefinitely as its velocity approaches the wave velocity.

The inertia or mass value of a given electrical charge (integral value of electric strain) increases as the charge is more and more concentrated, and the inertia or mass value increases with velocity, approaching infinity at the velocity of light. In case of the moving electric charge, however, the increase of mass value due to magnetic reaction (corresponding to inertia reaction in the jelly) does not affect the integral value of the electric strain, but merely concentrates the electric strain more and more into a plane perpendicular to the direction of motion.

A clear picture in two dimensions of an electron may be obtained by imagining massless points to rest with a certain force against a horizontal stretched sheet of rubber, each point producing a deep funnel-like depression. The mass value of each depression for given force pushing the point down is greater and greater the smaller the point.

This picture is, however, incomplete in several respects, notably in that two depressions (two negative charges) attract each other while a depression and an elevation (a positive and a negative charge) repel. This is due to the essential differences between electric stress and any kind of mechanical stress.

A clear picture in two dimensions of a system of negative electrons moving about in a region of distributed positive charge—Professor Thomson's hypothetical atom—may be obtained by imagining a wide and shallow saucer-like depression in a rubber sheet in which a number of point depressions are moving about and held together as a system by the gradient of the saucer-like depression.

Such a system moving as a whole would owe its mass value chiefly to the concentrated point-like depressions, inasmuch as the broad and shallow saucer-like depression would have a negligible mass value, as explained above.

Some striking features of the dynamics of an electron are the following (see paper by M. Abraham, *Ann. der Physik,* January, 1903). These features depend partly upon the above-described increase of mass value of an electron with increasing velocity partly upon the slight delay between a given assumed change of velocity of the electron and the consequent rearrangement of the surrounding electromagnetic field, and partly upon the fact that an *accelerated* electron radiates energy in the form of waves like a steadily moving boat.

The mass value of an electron moving at given velocity as measured by the acceleration produced by a given impressed force varies with the direction of the force, being greatest in the direction of the motion (longitudinal mass) and least at right angles to the direction of the motion (transverse mass). Furthermore, the acceleration is in general not in the direction of the accelerating force; the relation between force and acceleration being represented by the relation between the diameter of a circle (sphere) and the corresponding radii vectores of an ellipse (ellipsoid) in the drawing which is ordinarily made by students to show the projection of a circle into an ellipse (a relation known as the linear-vector-function).

An electron moving uniformly in a circular

orbit has acceleration and radiates energy so that its motion dies away. The dying away of the motion of a circular row or ring of electrons in this way is excessively slow if the number of electrons in the ring is great and if the velocity is small as compared with the velocity of light (see J. J. Thomson, *Phil. Mag.*, December, 1903). In fact, the time required for the angular velocity to fall from a value slightly above the critical value required for stability to the critical value might easily be a matter of millions of years under certain conditions.

It is interesting to note, although perhaps useless, considering the widespread confusion of the fundamental ideas of thermodynamics, that this electron theory, pointing as it does to finite systems which apparently never can settle to thermal equilibrium, suggests a class of phenomena, sensible and *steady* phenomena too, which are on the wrong side of thermodynamics, that is, on the side opposite to mechanics; phenomena which are to be treated by developing a systematic theory of atoms as isolated systems and the subsequent merging of this systematic theory of single atoms into a statistical treatment of aggregates of atoms; but this is another story. W. S. F.

## A HEAVY JAPANESE BRAIN.

THROUGH the kindness of my friend, Mrs. Helen H. Gardener, now in Tokio, I am able to publish the following extract from the post-mortem examination of Professor K. Taguchi, the celebrated anatomist, of the College of Medicine in the Tokio Imperial University. His death took place in Yumi-cho, Hongo, on February 4 of this year, and, in accordance with the terms of his will, his body was dissected by his colleagues at the college. Professor Taguchi is perhaps the first of his race to bequeath his body in this manner. His work on the brain-weight of the Japanese has been referred to by the writer in SCIENCE (September 18, 1903). His own brain is the heaviest on record among the Japanese, and in the list of eminent men throughout the world, whose brains have been weighed (107 in number) it occupies second place. Taguchi's brain-weight (1,920 grams or 67.7 oz. avoir.) exceeds the highest recorded Japanese brain-weight by 130 grams (or 4.5 oz.).

"Extract from report of the post-mortem examination of Professor K. Taguchi on February 5, 1904, in the Pathological Institute, Tokio, by Professor Dr. K. Yamagiwa:

"Age, 66 years.

"Body-weight, 49,000 grams.

"Brain-weight, 1,920 grams.

"Clinical diagnosis: Cirrhosis of the kidney.

"Anatomical diagnosis: Hypertrophy with dilatation of the left ventricle of the heart; endocarditis valvularis chronica fibrosa adhæsiva aortica; endocarditis valvularis chronica fibrosa mitralis; œdema pulmonum; hypostatic pneumonia of lower lobe of left lung; nephritis chronica interstitialis; cystic degeneration of the kidney; atheroma in the aorta." EDW. ANTHONY SPITZKA.

## PROFESSOR RUTHERFORD ON RADIUM.

PROFESSOR E. RUTHERFORD, of McGill University, lectured before the Royal Institution on May 20, on 'Radiation and Emanation of Radium.' According to the London *Times*, the lecturer first showed the power of radium to excite phosphorescence and to discharge a charged electroscope, and then described the properties of the three kinds of rays which it had been found to give off. In addition it gave off an emanation which behaved like a gas and could be condensed by cold; it could also be secluded in the radium itself, and was liberated when the salt was dissolved in water. This emanation, though exceedingly minute in quantity, possessed three-quarters of the characteristic powers of radium and all its properties. If we could collect a cubic inch of the emanation, the tube that contained it would probably melt, while a few pounds would supply enough energy to drive a ship across the Atlantic, though each of those pounds would require 70 tons of radium to supply it. In regard to the process going on in the emission of the emanation, he advanced the theory that radium was continuously producing it, but that when produced, instead of remaining constant, it was continuously being changed into something else. He supposed that some atoms of the radium in some conditions be-

came unstable; then there was an explosion, and particles of matter were shot off at great velocities. There was a series of such explosions, due to atomic, not molecular, changes, and resulting in the formation of a series of transition elements. A mass of radium left to itself must therefore throw itself away; probably in about 2,000 years its radio-activity would fall to half value, and after 50,000 years it would cease to exist. It was therefore to be supposed, since radium was produced from minerals more than 50,000 years old, that it was being itself produced from something else, and was itself a transition element. A year ago to find evidence for this point of view did not seem a very promising task, but since then a great deal had been done. In the self-destruction of radium two things must be produced that were not radio-active—the $a$-ray and the final product. Now helium was always found associated with radium-minerals, and the suggestion that that gas was one of the products had been confirmed by Sir William Ramsay, who had shown that the emanation was able to produce helium from itself. Here there was apparently a definite case of transmutation, though not precisely of the kind sought after by the alchemists, but there was no evidence as yet that matter in general, apart from the radio-active bodies, was undergoing changes of this nature. Radium was distributed very widely over the earth; in fact, was present everywhere, though in exceedingly minute quantities. The question was thus suggested—How much heat were these minute quantities of radium able to provide, and could they account for the gradual increase of temperature found as we went deeper into the earth? The lecturer himself believed that the amount of radium present, uniformly distributed, would be sufficient to account for all the heat lost from the earth and would explain the temperature-gradient as measured to-day. In that case the date, as calculated by Lord Kelvin, when this globe would have so far cooled as to be uninhabitable might possibly be postponed for a few million years, and an end put to the troubles of the biologists and geologist about a little extra time in the past.

## SCIENTIFIC NOTES AND NEWS.

The International Association of Academies met at London at the end of May as the guest of the Royal Society and the British Academy. The National Academy was represented only by its British foreign members. No information concerning the scientific work of the association appears to have been made public.

At a recent meeting of the Board of Managers of the New York Botanical Garden, Dr. D. T. MacDougal was advanced from the post of director of the laboratories to that of assistant director of the institution. Dr. W. A. Murrill was appointed assistant curator in charge of the fungi to take the place of Professor F. S. Earle, who recently resigned to take the position of director of the Estacion Agronomica of Cuba.

Dr. E. L. Greene, head of the Department of Botany of the Catholic University of America, has resigned to accept a position in the Smithsonian Institution.

Sir William Ramsay was elected an honorary member of the Bunsen Gesellschaft, at the recent meeting in Bonn.

Sir William Huggins has been elected an honorary member of the Royal Philosophical Society of Glasgow.

M. Bigourdan has been elected a member of the Paris Academy of Sciences in the section for astronomy.

Dr. E. Strasburger, professor of botany at Bonn, has been elected a foreign member of the Academy of Sciences at Christiania.

The New York *Evening Post* states that Professor Henry R. Mussey, of the University of Pennsylvania, has been engaged by the Carnegie Institution to make a special study of the iron industry in the United States.

Dr. H. Austin Aikins, professor of philosophy in Western Reserve University, has sailed for Europe on leave of absence for the coming year.

Mr. and Mrs. T. D. A. Cockerell will spend the summer in England; upon their return to

Colorado in September, Mrs. Cockerell will take the position of teacher of biology and physiography in the State Preparatory School at Boulder. In this work she will be assisted by Mr. Cockerell, who will also conduct a research laboratory in the University of Colorado.

Professor T. Steinmann has returned to Freiburg from geological and paleontological explorations in Bolivia.

Foreign papers report that Dr. Gottfried Merzbacher, who has been engaged for two years on a scientific expedition in the Thian-shan Mountains, in Central Asia, has returned to Munich with many objects of geological, paleontological, zoological and botanical interest.

It is reported that Lieutenant Peary has chartered the sealer *Eagle*, at St. John's, Newfoundland, for a cruise to Littleton Island, from July to September, in preparation for a four years' stay in the Arctic regions.

Dr. Alës Hrdlicka, of the U. S. National Museum, has been elected a corresponding member of the Czecho-Slavonic Ethnological Society of Prague.

Dr. Burton E. Livingston, assistant in the Department of Botany, of the University of Chicago, has been awarded the Walker prize by the Boston Society of Natural History for a paper on 'Ionic Stimulation in Plants.'

The Council of the Geological Society of London has awarded the Daniel Pidgeon fund to Mr. Lindsdall Richardson.

Mr. Percy Wilson, administrative assistant in the New York Botanical Garden, has accepted the position of assistant botanist of the Estacion Agronomica of Cuba. Mr. W. T. Horne, fellow in botany in Columbia University, has been appointed assistant pathologist in the same institution.

The Rede lecture at Cambridge will be delivered on June 11, by Dr. J. A. Ewing, F.R.S., upon 'The Structure of Metals.'

We learn from *Nature* that a mathematical society of Vienna has been organized, the meetings of which are to be held monthly. The officers are Messrs. G. von Escherich (president), E. Müller and W. Wirtinger (vice-president), A. Lampa (secretary), and A. Gerstel (treasurer).

The death is announced of Senator Gaetano Georgio Gemmellaro, the Italian geologist; of Professor Lengemann, who held the chair of mining in the Technical Institute at Aachen, and of Mr. Frank Rutley, the British geologist.

The Weights and Measures (metric system) Bill before the British parliament has been read a third time and passed by the House of Lords.

The Chicago Academy of Sciences has secured the collection of Lower Coal Measure plants made by Dr. John H. Britts, of Clinton, Iowa. The collection contains many species, named by Lesquereux, besides numerous cotypes of species, described by David White in Monograph 37, U. S. Geological Survey, on the 'Fossil Flora of the Lower Coal Measures of Missouri.' The collection was obtained through the generosity of Mr. Francis S. Peabody, of Chicago.

Five hundred mechanical engineers, representing the United States and foreign countries, were present on May 31 at the opening of the forty-ninth annual meeting of the American Society of Mechanical Engineers, which was a joint meeting with the Institution of Mechanical Engineers of Great Britain. Addresses were made by Mr. Ambrose Swasey, president of the American society, and Mr. J. P. Hartley Wicksteed, president of the English organization.

The Philadelphia Botanical Club and the Torrey Botanical Club will hold a joint field meeting at McCall's Ferry, Pennsylvania, in the valley of the Susquehanna River, July 2 to 9, 1904, which all botanists are cordially invited to attend. Excursions will be made from this point as a center, to points in the vicinity, returning each day; botanists can, therefore, conveniently take part in the meeting by arriving at McCall's Ferry any afternoon during the week. Informal evening conferences will be held for the discussion of topics that may be brought forward. Fares to McCall's Ferry are as follows:

Philadelphia to McCall's Ferry and return..$3.36
New York to McCall's Ferry and return.... 6.96
Washington to McCall's Ferry and return... 4.06
Hotel charges at McCall's Ferry are $1.25 per day.
Guides: Messrs. Stewardson Brown and Jos. Crawford.

An International Maritime Congress was held at Lisbon in the hall of the Geographical Society from the twenty-second to the twenty-eighth of May. The program of subjects was as follows:

I. *Oceanography and Hydrography.*—Bathymetric charts. Last cruise of the Princess Alice yacht. Lithobiologic charts. Unification of the scale of marine charts.

II. *Meteorology.*—The north Atlantic and forecasts of the weather in Western Europe.

III. *Territorial Waters.*

IV. *Congresses and Conferences.*—Summary of the work relative to maritime questions.

V. *Institutions for assistance to seamen.*

VI. *International maritime statistics.*

VII. *Panama interoceanic canal.*

VIII. *International Maritime Union Convention.*—Concordant measurement. Load line. Quay dues on the net or the gross tonnage. Lanes for ship routes. Signals in fogs at sea. Navigation rules. The prevention of collisions. Organization for life saving on board. Lighting and buoying of coasts. Condemnation of ships by experts. General average. Non liability clauses in Bills of Lading.

IX. *Yachting.*—International unification of measurement and rules for racing. Decimalization applied to navigation.

X. *Sea Fishing.*—Steam trawlers. The sardine question.

XI. *Wireless telegraphs and telephones.*

XII. *Port improvements and manutention.*

The International Maritime Association, under whose auspices this congress was held has a permanent office at 3 rue des Mathurins, Paris.

The captain of the ship *Godthaab,* which arrived from Greenland, at Copenhagen, on May 24, reports that the Danish Polar Expedition, led by the author Mylius Erichsen, left Saunders Island, where the explorers had lived for a long time among the Eskimo in the native fashion, on January 20, and, traveling by sledges, safely reached Upernivik, in West Greenland. Afterwards they proceeded to Umanak. The expedition will probably come home in the autumn.

*Nature* states that a series of prizes is offered by the mathematical and natural science section of the Jablonow Society of Leipzig for themes connected with the following subjects: For 1904, the chemical differentiation of rock magmas; for 1905, the causes of plasmic currents in vegetable cells; for 1906, the analogues of Bernouilli's numbers in the study of elliptic functions; and for 1907, the laws of photoelectric currents. Full particulars are obtainable from the secretary, Professor Wilhelm Scheibner, 8 Schletterstrasse, Leipzig. The Royal Academy of Sciences of Madrid offers for 1905 a prize for the best essay written in Spanish or Latin on the following subject: 'A complete study of a special class of singular integrals arising from differential equations for which the values of the derived functions become indeterminate when certain relations exist between the simultaneous values of the principal variables.'

The *Monthly Weather Review* reports that by the joint efforts of the Italian Alpenverein, the Duke of Abruzzi, the Minister of Agriculture for Italy, and Queen Margarhita, a geophysical observatory on the summit of Monta Rosa, at an altitude of 4,560 meters, has been erected. It is the highest in Europe, except that of Vallot, on Mont Blanc, and higher than the station on Pike's Peak formerly occupied by the Weather Bureau. The regular observational activity will begin this summer. It will be occupied in the winter time as well as in the summer if the severity of the weather does not prevent. Both the observatory and the hut of refuge for mountaineers will be accessible, not only to Italian but to foreign students who wish to carry on geophysical investigations. The meteorological observations are expected to be of especial importance in connection with the simultaneous international balloon ascensions. Italy now possesses three mountain observatories, namely, Monta Rosa, 4,560 meters; Ætna, 2,942 meters; Cimone, 2,162 meters.

*Nature* says of the late Professor His: "Professor Wilhelm His, whose death was announced from Leipzig on May 1, at the age of seventy-three, altered and extended our knowledge of human anatomy more than any

man of his time. He discovered and wrote the history of the human body during the first and second months of conception, and thus filled in what, until his time, was almost a blank. He introduced more accurate methods of studying the form and relationships of the various organs of the body. Pupils went to him from all parts of the earth and carried back to their native universities the quiet, honest spirit of investigation, the complete methods and the accurate technique His had introduced in his laboratory at Leipzig. His influence to-day is world-wide; it is especially evident in the remarkable progress in embryological research made recently in the United States. As His entered to lecture one was struck by the absence of those bodily features one expects in a German professor. He was a Swiss by birth and education, having been born at Basel in 1831; in appearance he might have been an Englishman. His narrow, longish head, black hair, regular profile, long sallow face, and nervous temperament indicated his descent from a Celtic stock. He taught quietly, clearly and concisely, illustrating his subject as he spoke by marvelous drawing on the blackboard. He relegated lady-students to the back-bench. Long after the university doors were shut, a light could be seen in the window of his private room, for to him work was also amusement.

The Cumberland Gap coal field of Kentucky and Tennessee is growing steadily in importance, although most of this area, which forms part of the eastern edge of the Appalachian coal field in southeastern Kentucky and northern Tennessee, is now without transportation facilities. The production of coal from the vicinity of Middlesboro has reached an annual output of from 600,000 to 1,000,000 tons. Bennett Fork has become a mining town for a continuous distance of five miles, and Stony Fork, up which a railroad is just completed, promises soon to become equally active. These and other evidences of rapid development, together with the fact that no government report has ever before been published about Cumberland Gap coals, give especial interest and value to a paper written by Mr. George H. Ashley about this field. This paper is included in a bulletin (No. 225) entitled 'Contributions to Economic Geology, 1903,' recently published by the U. S. Geological Survey for gratuitous distribution. Mr. Ashley's paper is merely a preliminary abstract of a more detailed report, which will be prepared under a cooperative arrangement made between the U. S. Geological Survey and the state of Kentucky. This report will fill several hundred pages and will be fully illustrated with appropriate plates, coal sections and maps.

The *Journal of Philosophy* summarizes the program for the season of 1904 of the Glenmore Summer School of the Culture Sciences, founded in 1889 by Thomas Davidson. The session will begin on July 11 and extend to September 3. Lectures are announced for Mondays, Tuesdays, Thursdays and Fridays at 11 A.M., and Sundays at 11:30 A.M. There will be informal discussions relative to the subjects of the lectures of each week on Wednesday evenings. The following lectures are announced: weeks beginning July 11 and 18, Charles W. Bakewell, Ph.D., of the University of California, on 'The Philosophy of Plato'; week beginning July 25, Leslie Willis Sprague, lecturer for American University Extension Society, Philadelphia, on 'Ralph Waldo Emerson'; week beginning August 1, Charles G. Child, Ph.D., L.H.D., of the University of Pennsylvania, on 'The Making of English Literature'; week beginning August 8, Hon. Chester Holcombe, A.M., Ex-Minister to China, Lowell Institute Lecturer, 1902, on 'The Religion and Literature of China'; week beginning August 15, Felix Adler, Ph.D., of Columbia University, on 'The General Theory of Social Ethics,' and Edward G. Spaulding, Ph.D., of the College of the City of New York, on 'Dogmas in Philosophy and Science'; week beginning August 22, Alvin S. Johnson, Ph.D., of Columbia University, on 'Some Aspects of the Labor Question'; week beginning August 29, J. Mark Baldwin, Ph.D., LL.D., of Johns Hopkins University, on 'Social Psychology.' There is a possibility that a few additional lectures may be given during the summer by Professor W. T.

Brewster, Ph.D., of Columbia University, and by Professor Lightner Witmer, Ph.D., of the University of Pennsylvania, on literature and psychology respectively. For particulars of the session, Professor Stephen F. Weston, of Yellow Springs, Ohio, should be addressed.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

Mrs. Amanda W. Reed, has provided in her will for the foundation of an institution at Portland, Ore., to be known as Reed Institute, in memory of her husband, the late Simon G. Reed. The bequest will amount to about $2,000,000. Her will specifies that the institute shall combine instruction in the fine arts and sciences and manual training, and that it shall be conducted with especial regard to the needs of young men and women compelled to earn their own living.

President B. I. Wheeler, of the University of California, president of the department of Higher Education of the National Educational Association, has completed the program for the session of the department which is to be held at the St. Louis Exposition on June 29 and July 1. The two subjects chosen for discussion are 'Coeducation in Relation to Other Types of College Education for Women' and 'The Present Tendencies of College Athletics.' The speakers with their subjects include: June 29—President Charles F. Thwing, Western Reserve University, 'The Women's Annex Versus Coeducation'; President Charles W. Dabney, University of Tennessee, 'The Experience of the South in Regard to Coeducation and Other Forms of Education for Women'; President R. H. Jesse, University of Missouri, 'Coeducation as It Has Been Tested in the State Universities'; President G. Stanley Hall, Clark University; President James B. Angell, University of Michigan. July 1—Chancellor E. Benjamin Andrews, University of Nebraska, 'The General Tendency of College Athletics'; President W. H. P. Faunce, Brown University, 'College Athletics'; Chancellor Frank Strong, University of Kansas, 'The Highest Standards of College Athletics—Outright Amateurism.'

The College Entrance Examination Board will hold examinations during the week, June 20 to 25, at about one hundred and fifty points throughout the United States and at London, Paris, Geneva, Strasburg, Dresden and Frankfort. The readers in the sciences are: *Mathematics*—Professor R. W. Prentiss, Rutgers (chief reader); Professor C. E. Biklé, Teachers College; Miss Elsa Bowman, Brearley School; R. H. Bright, Paterson High School, H. H. Denio, Collegiate School; C. S. Forbes, Columbia; J. R. Gardner, Irving School; W. A. Johnson, Hasbrouck Institute; E. H. Koch, Jr., Mackenzie School, Dobbs Ferry, N. Y.; W. E. MacDonald, Massachusetts Institute of Technology; R. Morris, Rutgers, Miss Gertrude Smith, Vassar; Professor Virgil Snyder, Cornell; Miss Roxana H. Vivian, Wellesley; H. E. Webb, Stevens Preparatory School, Hoboken. *Physics*—Professor A. W. Goodspeed, Pennsylvania (chief reader); Professor J. M. Jameson, Pratt Institute; Dr. G. B. Pegram, Columbia. *Chemistry*—Professor J. F. Norris, Massachusetts Institute of Technology (chief reader); Professor C. M. Allen, Pratt Institute; Dr. V. J. Chambers, Columbia. *Botany*—Professor W. W. Rowlee, Cornell (chief reader); Miss Elsie Kupfer, Wadleigh High School. *Geography*—Professor R. E. Dodge, Columbia (chief reader); W. W. Clendennin, Wadleigh High School.

The Rev. Samuel Black McCormick, a Presbyterian clergyman, since 1897 president of Coe College, at Cedar Rapids, Ia., has been elected chancellor of the Western University of Pennsylvania.

Dr. F. G. Donnan, lecturer in chemistry in the Royal College of Science, Dublin, has been elected to the chair of physical chemistry recently founded by Sir John T. Brunner in the University of Liverpool.

At Cambridge Mr. W. J. Sell, F.R.S., and Mr. H. J. H. Fenton, F.R.S., are to be appointed university lecturers in chemistry, and Mr. A. Harker, F.R.S., a university lecturer in petrology.

Dr. O. Aschan has been appointed professor of chemistry in the University of Helsingfors.

Dr. George Landsberg, of Heidelberg, has been called to an associate professorship of mathematics at Strasburg.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 17, 1904.

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE CONTINUOUS ADVANCE OF ELECTROCHEMISTRY.*

THE field of electrochemical activity covers three distinct lines of endeavor: First, the investigation and classification of electrochemical phenomena—scientific progress; second, the formulation of a satisfactory and all-comprehensive electrochemical theory—intellectual progress; and third, the application of these facts to industrial ends—industrial progress. We purpose to discuss briefly this evening the past achievements in each of these lines of endeavor, in order to determine therefrom and to discuss more at length the present bent and probable future direction and extension of each.

### I. THE INVESTIGATION AND CLASSIFICATION OF ELECTROCHEMICAL PHENOMENA.

This is, properly speaking, the real corner-stone of progress in electrochemical science. What has been accomplished in this direction in the century and a half since Beccaria 'revivified' several metals by Leyden-jar discharges may be found scattered through the files of our technical journals and compiled from time to time into compendiums of electrochemical literature. The most pretentious, and in many respects the most timely, of all these works is the 'ausführliches Handbuch,' which our German friends are at present patiently compiling. A careful study of this work causes surprise both at the large amount of investigation which has been done and at the large gaps which exist in our experimental knowledge. Alongside of splendid researches into the most obscure phenomena of the science exist *lacunæ* in

our knowledge of some of the simplest electrochemical phenomena, such as, for instance, in the facts concerning the simultaneous deposition of two or more metals from solution. While doing this the impression grows strong upon us that electrochemistry has lost much because of a lack of cooperation among electrochemical investigators, and because of the desultory, haphazard manner in which their efforts have been frequently applied.

The lack of a coordinating, directing, systematizing influence among electrochemical workers has been the crying need of the science, and it is just this influence, above all things, which is furnished by our electrochemical societies. The Bunsen Society in Germany, the Faraday Society in England, our own society in America have brought electrochemists together, making them acquainted with each other's work, and in particular with the need of experimental work along neglected lines, and have thus furnished the coordinating agency until recently so deplorably lacking.

Davy and Faraday laid broad the experimental foundations of this science by the electrolytic decomposition of many of our most common chemical compounds. Bunsen supplemented this by attacking the rarer metals. Kohlrausch investigated specific conductivities of almost numberless solutions. Beetz and Lorenz fused salts; Moissan the electrochemistry of high temperatures; Hittorf and Ostwald and Nernst the mechanism of electrolysis of solutions, while in between these monumental investigations hundreds of others have contributed to the advance. But still if the army of investigators, as regards numbers, had been in reality an army as regards organization and systematically directed effort, how much more valuable would its work have been! Is it not a fact that one of the results of our semi-annual meetings is that we learn and have impressed upon us the gaps in experimental electrochemistry, and that we often, either deliberately or tacitly, divide the work among us for systematic investigation?

Let me indicate some of the many electrochemical subjects which need systematic attack and orderly study. The electric conductivity of some common salts is as yet undetermined, not to mention most of the rarer ones. Braun, Graetz and Poincairé did good work on the conductivity of fused salts many years ago, but for every salt they tested there are a dozen or a score awaiting investigation. The results of the electrolysis of solutions of different salts, of different concentrations, at different temperatures, with differing electrodes and current densities, has been merely touched here and there; the great body of that information is ripe for harvest to whoever can wield the sickle. The study of the electrolysis of fused salts, or of solutions of chemical compounds dissolved in fused baths, is scarcely begun. One can go into the laboratory any afternoon and start an electrochemical study of a salt which has never before been taken up, and there are enough such to keep the laboratory busy a long, long time.

The use of accurately controlled electrodeposition for the purpose of determining the chemical equivalents of the metals is a method which has not received the attention which it deserves. It is quite certain that the atomic weights of many elements, whose exact value is at present uncertain, could be fixed satisfactorily in this manner. The calorimetric investigation of electrolytic cells in operation, inaugurated by Faure, is an attractive field wide open for the experimenter, and from which much valuable information could be drawn. Besides these, the deposition of alloys, the solution of alloys, the electrolysis of mixed electrolytes, the function of intermediate (bi-polar) electrodes, the exact *modus oper-*

*andi* of porous diaphragms, the relation of viscosity to electric conductivity and ionic mobility, the limitation of the speed of electrolysis by the diffusibility of the products, the solubility of metals in their own fused salts, the function of gases in solution, the compounds of solvent with solute and their relations to complex ions and the mechanism of electrolysis, are only some of the many phenomena whose investigation has only begun, and which lie invitingly before us. Professor A. A. Noyes has blazed a new trail by his systematic work on the electric conductivity of solutions at high temperatures, and Dr. Kahlenberg by his researches on the electrolysis of non-aqueous solutions. Let these advise us that there are as many new fields awaiting attack as there are old ones needing thorough exploration.

In the whole realm of pure science (meaning thereby the investigation and classification of phenomena) there is no field offering more attractions at the present moment, none more ripe for exploitation, none more promising of large rewards for honest work, than electrochemistry. The science is yet in its infancy; many of its pioneers are yet living (the original patentee of nickel plating contributes a paper to this very meeting), and the gates of opportunity are opened wide to every one of us to go do likewise—to become pioneers in our turn.

II. THE BUILDING OF A COMPREHENSIVE ELECTROCHEMICAL THEORY.

In this respect we must confess at the outset that our science is in a state of transition. We know what we are abandoning, we hardly as yet grasp the newer theory to which we are groping our way. In the past plausible explanations have been advanced which fitted the known facts fairly well, only to be afterwards shattered by new facts which could not be made to fit into the theory. Scientific theories must enlarge to fit the new truth or be broken by it, and so our theories must be in a state of constant flux if the science to which they belong is a live, growing science, receiving continually accretions of new truth.

Not very long ago the burning electrochemical question was, 'Is the theory of electrolytic dissociation the true explanation of the nature of a solution?' I shall not say that it is not, because I do not know; but I am certain that the man is making a mistake, whoever he may be, who says that 'it is certainly true.' My own conception of the state of solution is that the solute is in an abnormal *physical* state, having resemblance to the gaseous state, and that in some cases a definite compound of the solute with the solvent exists in the solution, it also being in the abnormal physical state, but not abnormal chemically. The grounds for this view would take too long to explain, but they appear to me to point to this as an explanation more satisfactory than the assumption of an abnormal chemical condition of dissociation.

Large generalizations like the theory in question, however, are very seldom directly proven false; the evidence of their insufficiency simply accumulates until the conviction arises or grows in men's minds that something else explains the facts better, and the older theory thus fades into the background. At the present time the physical chemist, or perhaps rather the chemical physicist, has thrown so much light upon the structure of the atom by his discoveries regarding electrons that it appears as if a new and a very brilliant side-light is about to be thrown upon the subject of electrochemical phenomena. If it be true, as Professor J. J. Thomson has apparently just proved, that the arrangements of the elements in families according to the periodic law, their periodic increase and decrease in valence, and change from electropositive to electronegative character, can

be postulated as a necessary deduction from the hypothesis of the atoms consisting of uniform shells of positive electricity, inclosing negative electrons arranged in rotating rings, then the ionic conception will of necessity yield place in electrochemical science to the electronic. In this connection it ought to be noted that Professor Thomson's inferences as to what constitutes chemical combination, the electrically neutral atoms losing or gaining electrons and thus becoming positively or negatively electrified, and therefore attracting each other, agree with and supplement to a nicety the system of positive and negative bonds elaborated twenty-five years ago by our respected member, Professor O. C. Johnson.

The nature of the act of solution bears so fundamentally upon the mechanism of electrolysis that light thrown upon it from any direction is very welcome. Professor J. H. L. Vogt, of the University of Christiania, has recently published the first section of a work on the nature of fused silicates which bears so directly upon the question of fused baths, and particularly of the condition of compounds dissolved in fused baths, that the close study of his work will undoubtedly assist the electrochemist in understanding fused bath electrolysis and, in fact, the problem of solution in general. It is, indeed, the fact that many bases dissolved in fused silicates retain their chemical individuality, and can be proved to exist there simply in an abnormal physical condition. The analogous process in regard to solution in water passes current under the name of ionization, or electrolytic dissociation. From these and similar investigations the conviction is being pressed upon us that physical solution of one substance in another covers a large part of the field formerly supposed to be entirely chemical in its nature, and that the eutectic mixtures resulting are in no sense chemical compounds, but that the latter constitute nodes or critical points of the mixtures, while in between, in the ordinary run of solutions, we are dealing simply with these chemical compounds mutually dissolved in each other, and in no other states than abnormal *physical* states. The electrolysis of a substance in solution means usually, therefore, the decomposition of that chemical substance existing in an abnormal physical state, and not the act of gathering at the electrodes the ions of the previous dissociated chemical compound.

These are the personal views of your speaker, and are, of course, not put forward as necessarily representing those of any other member of this society. They are given here because I believe that the advance in electrochemical theory in the near future will be in this direction and along these lines.

III. APPLICATIONS TO INDUSTRIAL NEEDS.

If electrochemistry concerned itself only with the study of phenomena and their classification, the deduction of laws and the building of theories thereupon, it would satisfy one of the fundamental needs of the human mind, that of *knowing*, but would leave unsatisfied another and equally vital desire, that of *using*.

As one indication of this we see the program of our meeting classified into experimental, theoretical and industrial. (I stand convicted of having plagiarized the plan of the program in laying out the subjects of my address.) Without the latter item the electrochemical field would remain a thing apart from the sympathy of the world at large, and it is really by reason of the absorbing interest and great economic value of these industrial applications that we have with us the support and cooperation of the educated and the commercial world.

The various items in which, in industrial chemistry and metallurgy, electrochemical

methods have either superseded ordinary non-electric methods, or else have created new industries, form a catalogue sufficiently long to arrest the attention of the most superficial observer, and altogether too long to be mentioned in detail within the limits of this address. Suffice it to mention in passing the millions of dollars' worth of copper electrolytically refined, not annually, but monthly; the 100,000 horse-power consumed in producing calcium carbide; the reduction of the cost of aluminium from $5 a pound to 30 cents; of sodium in almost an identical ratio; the revolution being wrought in one of the largest chemical industries by the production of electrolytic alkali and bleach; the capturing of the potassium chlorate industry and the manufacture of phosphorus.

The whole story, if related at length, would be the old story of *homo sapiens* having discovered a new tool, a new instrument wherewith to torture mother nature; a new means of reaching old or of creating new results, and he is necessarily immersed in enthusiasm for this 'genius of the lamp,' which has performed so many wonders and promises so many more. For the use of electricity puts at our disposal temperatures never before industrially attained; gives us a decomposing agent at whose bidding the most powerful chemical compounds resolve into their constituents; enables us to attack and solve chemical problems in a manner before unthought of; opens up a world of possibilities whose scope we even yet but dimly comprehend. This is the fascination of the subject, the attractive force, the absorbing interest which is reflected in the enthusiasm of the electrochemist for his profession and in the gratifying success which has attended the formation and growth of this electrochemical society.

It remains to speak, with as much definiteness as the subject permits, of the possible enlargement and extension of these industrial applications. 'Whither' is a more important question than 'whence' when the present prosperity and future progress of the art are concerned.

Basing our remarks upon present developments, it may be perceived, to start with, that the electrical methods in chemistry and metallurgy which are most successful are either, *first,* those applied to the more powerful chemical compounds, whose decomposition by non-electric methods is highly difficult and expensive, or else impossible; or, *second,* those applied to new fields of very high temperature reactions impossible of attainment by other means, or, *third,* those applied to ordinary chemical processes, in which the directness of the electrical influence, be it decomposing, reducing or perducing, can not be duplicated or competed with by known non-electric methods.

Primitive man took his first lesson in metallurgy by learning to make iron; to this the ancients added lead, copper, silver, gold and even the volatile mercury. Many centuries later zinc was distilled, and only in the most recent times have sodium, aluminium and magnesium been possibilities. Painfully and slowly alchemy and modern chemistry toiled up the heights of the electrochemical series, from the easy conquest of the *noble* metals to the powerful mastery of the *strong* metals, and the steepest part of the ascent has been lightened by the aid of electricity, which has in many cases furnished the easy path to the conquest of the most difficult chemical problems.

It is related of our renowned geologist, Clarence King, that he was an enthusiastic mountain climber, and having from a distance spied a steep mountain, he conceived the ambition of conquering it. Taking a respite from surveying, he equipped himself for difficult climbing, and after several

hours of desperate effort finally stood on the summit of the seemingly impregnable butte, only to find an easy trail leading up on the other side.

The most abundant materials in nature are the fixed, difficultly transposable compounds of the strong metals, and their conquest and utilization are the peculiar and special province of electrochemistry.

According to the estimate of the indefatigable chemist of the Geological Survey, F. W. Clarke, silicon oxide forms 58.3 per cent. of the contents of the solid crust of the earth, aluminium oxide 14.7 per cent., iron oxide 7.8 per cent., calcium oxide 5.3 per cent. and magnesium oxide 4.5 per cent.; or, expressed in another way, silicon 27.2 per cent., aluminium 7.8 per cent., iron 5.5 per cent., calcium 3.8 per cent. and magnesium 2.7 per cent.

With these figures in mind, may I not ask whether we fully realize the significance of one of the latest electrometallurgical triumphs, the production of metallic silicon on a large scale in the electric furnace by one of our Niagara Falls members, Mr. F. J. Tone? While the catalogues of dealers in rare chemicals are still listing silicon at dollars an ounce, an electrochemist has two barrelfuls of it which he is wondering if any one will buy at a fraction of a dollar a pound! Could anything better illustrate the revolutionary character of electrochemistry? While the electrochemist is the reverse of a nihilist, we must admit that he is a typical and convicted revolutionist.

To say a word or two more about silicon. I had a somewhat uncanny feeling when Mr. Tone introduced me to his half a ton of silicon. "Here is," I soliloquized, "the first chance which mankind has had to utilize the most abundant solid element on earth. What will be made of it? Can it become as useful as iron? Probably not. Can applications be found for it which will bring it among the ordinary metals of every-day life? Possibly. In any event, here is the material, ready to hand, and no one but the electrochemist could have made it."

Something of the same feeling must have arisen in the mind of the chemist who first made aluminium a commercial possibility, but his expectations, based on his chemical process, were only actually realized when the electrochemist gave his solution of the problem. This very element illustrates one of the chief characteristics of electrochemical processes, viz., their potentiality for improvement. Chemically produced aluminium was out of the race when the metal sold for one dollar per pound, yet the present market price is only one third of that. After the chemical process has done its utmost, has said its last word, the electrochemical process, which supersedes it, has only *begun* its march of improvement.

In the metallurgy of iron, a direct replacement of the ordinary manufacture of pig iron by electrical processes is very far from a possibility, even in countries where coal is most expensive and water power most abundant. However, in the manufacture of that higher-priced product, steel, the case is different, and already some of the finer qualities, such as replace crucible steel, are being made electrically in France, Switzerland and Sweden. It is only a question of some more inevitable improvements being made in the electric furnaces used to make possible the manufacture in them of the more common and cheaper varieties of steel. This will come at first in countries where fuel is dear and power cheap, and afterwards in localities where very cheap power is being generated by gas-engines using either the waste gas from blast furnaces or producer gas made from coal waste or culm.

Even before that time the auxiliary use

of electric heating to take off the 'peak of the load,' so to speak, in our open-hearth steel furnaces—that is, to furnish the last few hundred degrees of necessary temperature while the combustion of gas furnishes the lower range—is a distinct commercial possibility. Already our steel works are a network of electrical appliances for running cranes, charging machines, hoists and cars, and the step is not a long one to employ this already-present agent to help the heating gases over the heaviest part of their work, the bringing up of the charge to tapping heat.

Next to iron in natural abundance is calcium, and our chemists and metallurgists are only beginning to appreciate its possibilities. Occurring as almost chemically-pure calcium carbonate, in inexhaustible quantities and at the cost of only a few cents a ton for quarrying, the question of producing the metal cheaply is the particular task of the electrochemist. The cost of the metal is practically the cost of its reduction, and there is no doubt that the electrometallurgist can and will solve this question as he has that of aluminium and silicon. Calcium is, at temperatures above a red heat, the strongest metallic base existing, and is therefore the most powerful pyrochemical reagent. By its use many problems may find their solution, such as the complete deoxidation of melted metals, the reduction of rare elements and many other interesting reactions.

Magnesium does not occur quite so plentifully as calcium, but still it is so common that 99 per cent. of the present cost of making magnesium must be charged against the process used and only 1 per cent. against the raw material. There is no reasonable doubt but that careful study put upon the electrolytic production of magnesium would result in its being produced at a fraction of its present cost. It is certainly a metal which, at its present price, has very limited uses, but, with a specific gravity of only 1.72, a capacity for being hardened and strengthened like aluminium and the property of forming valuable alloys with copper and with aluminium, it is certain that its cheap production would mean another metal added to those in everyday use.

There is yet another metal of kindred character worth considering. Beryllium occurs in the gem beryl as silicate of aluminium and beryllium. The mineral is found massive in large enough quantities to form a commercial source of the metal. The separation of the beryllium oxide from the silica and alumina is not a very difficult chemical operation, but could probably be simplified by the application of Hall's process of differential reduction in the electric furnace. The reduction of beryllium oxide to metal dissolved in a fused bath of alkaline and beryllium salt is a step which would probably yield to investigation, while the collecting of the metal floating upon the bath should offer no greater difficulties than does the collecting of sodium.

With a brilliant white color, specific gravity 1.6, malleable, ductile, forming fine alloys, there are a large number of possible applications for beryllium if it can be obtained cheaply, and it is to the electrochemist that we must look for the solution of this problem.

In the electrolytic refining of metals, copper was the first to yield commercial results, silver next, then gold, lead and bismuth. Yet there are others awaiting conquest. The electrolytic refining of nickel, zinc, antimony and tin has been attempted, but not yet commercially mastered; that of aluminium is an attractive question because of the economy it would produce. Instead of purifying by costly chemical methods four tons of aluminium ore, we have the alternative problem of refining one ton of impure aluminium, and with a large margin of difference in com-

mercial value to work upon. It may be, since electrolysis in aqueous solutions appears impracticable, that refining in non-aqueous solutions, or in easily fusible salts, would conquer the difficulty.

In the field of producing ferro-alloys of the rare metals, for use in making special steels, even the crude electric furnaces in present use have demonstrated their ability to produce these alloys at the minimum cost. Here is a field which has been practically occupied by electric-furnace methods, or by the Goldschmidt process, using electrolytically produced aluminium, and one does not need to be much of a specialist in chemistry or metallurgy to see the wide vista of commercial opportunities here opening before us.

While our largest electrometallurgical industry is that of copper refining, the largest industrial electrochemical operation is that of producing calcium carbide. Calcium carbide, a substance practically unknown to even the skilled chemist a few years ago, and now being produced by thousands of tons annually. Calcium carbide, the commercial key to the gateway first pointed out by Wöhler, when he made artificial urea.

But why only *calcium carbide?* This is only one of the numerous carbides first produced commercially by electrical methods. Silicon carbide is another which has found broad applications and formed a new industry, and it is not only possible, but most probable, that other metallic carbides may find large applications. Moissan has shown, for instance, that uranium carbide produces, with water, liquid hydrocarbons like petroleum, and the production of artificial petroleum is a scientific possibility, although not at present commercially practicable. Besides the carbides, there are other electric-furnace products—the metallic nitrides, which are awaiting further study and utilization.

One of the most vigorous and industrious electrochemists said to me once, "We are so overwhelmed by new things of possible use to science or industry that we can at most investigate only a small fraction of them. It is a virgin continent of undeveloped possibilities."

Of the possibilities of the direct preparation of metallic compounds from the metals, the transformation of metallic salts into other compounds, the fixation of the nitrogen of the air, the increased application of the simple, direct and elegant methods of electrolytic decomposition, reduction or perduction in organic chemistry, the electrification of soils and its influence on agriculture, the sterilization of water by electrically made ozone and the disinfection of sewage and their contribution to sanitary science, and the various other unmentioned possibilities of electrochemistry, time literally fails in a simple endeavor to mention, let alone to discuss them.

The great services which electrochemistry has rendered humanity, and the march of civilization in the past decades which measure its brief but phenomenal advance, are but a fraction and an earnest of what is yet to be accomplished. If in the battle of industrial competition you are summoned by the conservatives of industry to strike your colors, answer with the courage and determination of the intrepid Captain John Paul Jones, 'Surrender, sir! We have only begun to fight.'

Joseph W. Richards.
Lehigh University.

## *DISTRIBUTION OF INDIAN TRIBES IN THE SOUTHERN SIERRA AND ADJACENT PARTS OF THE SAN JOAQUIN VALLEY, CALIFORNIA.*

The distribution of Indian tribes in California has never been completely worked out. This is due partly to the difficulty of the undertaking but mainly to the inadequate amount of field work thus far

done in the state. The principal contribution to the subject is Stephen Powers's 'Tribes of California,' published in 1877. Powers's field work was done in the summers of 1871 and 1872, supplemented by a collecting trip in 1875 or 1876. The time at his disposal was limited, and most of it was given to the Indians of the northern half of the state, those of the southern half receiving very little attention. In discussing the distribution and relations of the southern tribes he was several times led into error, and in certain instances even referred to one stock tribes belonging to another. These errors were copied by Powell in his 'Indian Linguistic Families,' 1901.

Powers's work contains a large map showing the distribution of linguistic stocks in California, though it does not give quite all that are mentioned in the text. In the matter of nomenclature it obviously was worked over by Powell.

In 1891 appeared the Powell-Henshaw map of the linguistic stocks of North America, the California part of which is only slightly modified from Powers's map of 1877, the principal changes being in the names used for the stocks. In 1903 Dixon and Kroeber published a small map of the linguistic families of California, which, though not so credited, is copied from the Powers and Powell-Henshaw maps, with slight alterations on the northwest coast and a few changes in nomenclature. All of these maps are so generalized, particularly in the southern half of the state, that they fail to show the real boundaries of the areas and make no attempt to indicate the localities at which Indians actually live. They are misleading in that the areas allotted to the various stocks cover the entire area of the state, leaving no spaces between and no parts unoccupied. It is true that in many cases tribes were so numerous as to press closely upon one another, with definite boundaries between; but in other cases they were widely separated and there were large tracts wholly unoccupied.

The distribution of Indians conforms closely with that of the faunal and floral areas. Zoologists and botanists have found that animals and plants are arranged in definite belts the boundaries of which are determined by climatic conditions. In the northern hemisphere north of the tropics the northern zones are called Boreal, the southern Austral. In North America the Austral zones are called Lower Sonoran, Upper Sonoran and Transition; the Boreal zones, Canadian, Hudsonian and Alpine. In California no Indians live in the Boreal zones, and few if any in the upper half of the Transition zone, though certain tribes claim parts of these as summer hunting grounds. The great majority live in a single life zone—the Upper Sonoran; many in the Lower Sonoran, and a few in the Transition. The Lower Sonoran comprises the hot San Joaquin-Sacramento plain and certain outlying valleys, the Colorado and Mojave deserts, and small areas in the southern part of the state; the Upper Sonoran comprises the foothill or Digger pine belt of the Sierra, most of the coast ranges and valleys, most of the desert region of eastern California north of Owens Lake, and the greater part of southern California west of the desert; the Transition comprises the yellow of Ponderosa pine belt of the Sierra, the corresponding belt of other mountains, and a narrow strip along the humid coast.

For several years I have been engaged in mapping, for the U. S. Biological Survey, the distribution of plants and animals in California. This work takes me into all parts of the state so that I frequently come across camps of Indians belonging to different tribes. These tribes are so little known, and are disappearing so

rapidly, that I have felt it a duty to stop, whenever practicable, long enough to secure short vocabularies and find out who the various people are. Some are now on the verge of extinction and several are represented by only one or two living individuals. It is obvious, therefore, that whatever is to be learned from them must be learned at once.

Persons unfamiliar with this kind of work may be interested to know that the classification of tribes and stocks is based wholly on language. In most cases the numerals alone are sufficient for the purpose, but it is well not to rely on them too implicitly, for in certain cases they, as well as many other words, are strongly affected by contact with neighboring tribes. This is particularly true of remnants of tribes whose altered conditions have brought them into friendly intercourse with tribes with whom they were not formerly on terms of intimacy. Thus members of two disappearing California tribes (Ko-ko-he′-ba and Kosh-sho′-o) at first gave me numerals belonging to different linguistic families from those to which they respectively belong; but when their attention was called to the matter they promptly corrected the mistake. In another class of cases the effects of contact are so firmly incorporated into the language that the persons speaking do not realize that they are using borrowed words. Thus the Pakanepul of Kern Valley, assumed to be of Paiute origin because four of their numerals (2, 3, 5 and 6) and a few other words resemble or suggest those of the Paiutes, gave for 7 the Yokut word *num-chin*. This was not an accidental use of the word, for it was given me by three persons at different camps. Besides the numerals, it has been my practice to collect terms of relationship, names of animals and plants, and vocabularies of several hundred of what seem to be the more important words.

In the Sierra region the distribution of tribes conforms closely with certain faunal belts. The higher and colder belt, comprising the Boreal zones, is not inhabited, and only a few tribes go so high as the lower half of the Transition zone, most of them living in the Upper Sonoran or Digger-pine belt, which occupies the lower slopes and foothills. All the way from Sacramento canyon to Tehachapi, a distance of about 500 miles, fully 95 per cent. of the Sierra Indians dwell in this life zone. Most of the tribes live wholly within it and not one lives wholly above it.

The Southern Pacific Railroad crosses the Sierra Nevada between the Yuba and American Rivers in the territory of the Nis-se-non (or Nishinam), a branch of the so-called Midu (Mi-doo) stock. The Nissenon reach from Bear River on the north to the Cosumne River on the south. South of the Cosumne are the Mu-wa, called by Powell 'Moquelumnan.' The Muwa are one of the largest stocks in California. Their territory embraces the Upper Sonoran and lower half of the Transition zone of the west flank of the middle Sierra from the Cosumnes to Fresno Creek—a distance of 110 miles.

South of the Muwa, and ranging from Fresno Creek to Kern Lake and Tehachapi Basin, are tribes of two widely different linguistic families—Yo-kut and Pai-ute. These tribes are arranged in the main in parallel belts, the Yokuts occupying the lower and more westerly country, the Paiutes the higher and more easterly. But there is this important difference: The Yokut tribes are numerous, and until the confiscation of their lands by the whites their distribution was continuous, while the Paiute tribes are few and their distribution is and always was interrupted by broad intervals. Powers recognized the general facts that the Indians of this part of California belong in the main to the Yokut and

Paiute stocks; that the Yokut tribes were a peaceful people and were the earlier occupants of the region; and that the Paiute tribes were more powerful and warlike and entered at a later period. He states that bands of Paiutes, leaving their desert homes east of the mountains, had pushed through the passes of the Sierra, invaded certain valleys of the west slope, and driven out the Yokut people.

Tribes of other linguistic families inhabited the hot Tulare-Kern Basin and the region to the west and southwest, but they do not come within the scope of the present paper.

In the area south of Fresno Creek I have obtained vocabularies from eighteen tribes, of which nine are of Yokut origin and nine of supposed Paiute or Shoshonian origin.

### THE YOKUT TRIBES.

The country of the Yokuts comprises the eastern part of the San Joaquin Valley and adjacent lower slopes of the Sierra from Fresno Creek southward to the Bakersfield Plain. Their villages, when the whites first visited this part of California, were numerous and prosperous, and the territory claimed by the various tribes spread continuously from one end of the area to the other. The tribes were most numerous in the Kaweah Delta region and on Kings River and the San Joaquin. Food was abundant and easily procured and the population was large. Some of the early settlers estimated that at the time of their arrival the number of Indians in the Kaweah Delta was at least five thousand. But this region early suffered the usual results of the coming of the whites—first the Spaniards and Mexicans, soon afterward the Americans. Not only were the fertile valley lands taken possession of, but the rich harvest of acorns of the valley oaks was coveted by the hog men, who in their greed were not willing even to divide the crop with the native inhabitants. At the north end of Tulare Lake two or three tribes were rounded up by the hog men and brutally herded and driven north during the winter rains to the mountains northeast of where Fresno now stands. Many fell by the way, and some who escaped were 'taken care of on their return.' This and other exploits help to explain the almost complete extermination of the Tache, Natoonata and several other tribes. But this is not the place to tell of the outrages committed by the whites on these inoffensive people. Let it suffice that events and incidents connected with the establishment and growth of Visalia on the Kaweah River, and of the towns on Kings River, led to the destruction of numerous tribes. Nevertheless, remnants of at least nine Yokut tribes still exist. These, beginning at the north, are:

1. *Chuk-chan′-cy,* inhabiting the foothill country between Fresno Creek on the north and the San Joaquin River on the south, from a little above Fresno Flat in the lower part of the Transition or Ponderosa pine belt down to the site of old Millerton near the lower edge of the Upper Sonoran or Digger pine belt.

2. *Pit-kah′-te* (or *Pit-kah′-che*), on the south side of the San Joaquin below Millerton, in the Lower Sonoran zone. Only a few left.

3. *Kosh-sho′-o* (or *Gosh′-sho-o*), on Dry Creek and Table Mountain, in the Upper Sonoran zone. Nearly extinct.

4. *Cho-e-nim′-ne,* on Kings River at mouth of Mill Creek, and the closely related *Cho-ki′-min-ah* of Squaw Valley, both in the Upper Sonoran zone. Only a few families left.

5. *Wik-tchum′-ne,* on Kaweah River near Limekiln or Lemon Cove, on the border between the Upper and Lower Sonoran zones.

6. *Tā-dum′-ne,* formerly on Kaweah

River below Visalia, in the Lower Sonoran zone. Now nearly extinct.

7. *Na-too'-na-ta* (or *Nă-toon'-ă-tă*), formerly on Kings River north of Tulare Lake, near the abandoned town of Kingston, in the Lower Sonoran zone. Nearly extinct.

8. *Tah'-che,* on Tulare Lake, in Lower Sonoran zone. Only a few left.

9. *Yow'-el-man'-ne,* formerly on Bakersfield Plain and thence to Kern Lake, in Lower Sonoran zone. Only a few left.

THE PAIUTE TRIBES.

The country of the Paiutes, as every one knows, is the desert region east of the Sierra. The tribes of Paiute origin which invaded the Sierra and established themselves on the west slope are:

1. *Nim,* on North Fork of San Joaquin and adjacent region, in the Ponderosa pine or Transition zone. Called *Pă-zo-ōds* by their relatives, the Hol'-ko-mah. Those living in San Joaquin Canyon are called by the Wuksăche *Kash-ă-woosh-ah.*

2. *Hol'-ko-mah* (or *Hol-o'-kom-mah,* or *To-win-che'-bă*), on Sycamore Creek and Big Creek, north of Kings River, in the lower edge of the Ponderosa pine belt and upper edge of the Digger pine (borderland between Upper Sonoran and Transition zones). There is some doubt as to the proper name of this tribe.

3. *Ko-ko-he'-bă,* in Burr Valley, with one village over the divide, looking into the valley of Sycamore Creek, in the upper part of the Upper Sonoran or Digger pine belt. Only a few left.

4. *Em-tim'-bitch,* in the valley of Mill Creek, some miles south of its junction with Kings River, in lower half of Transition and upper part of Upper Sonoran zones.

5. *Wuk-să'-che,* in Eshom Valley north of Kaweah River, along the border between the Upper Sonoran and Transition zones.

6. *Pa-kan'-e-pul,* in valley of South Fork of Kern River, in the Upper Sonoran zone. They also call themselves *Te-bōt-e-lob'-e-lay* (meaning pine nut eaters). The Yowelmanne call them *Wah-lik-nas'-se.*

7. *New-oo'-ah,* on Paiute Mountain and neighboring region, from Kelso Creek on the north nearly to Tehachapi on the south, in Upper Sonoran zone. The name of this tribe in the languages of their neighbors, the Yowelmanne and Pakanepul, is *Kow-ă'-sah* or *Kah-wis'-sah.*

Geographically the Paiute tribes may be arranged in two groups, separated from each other by a considerable interval not inhabited by Indians of the same stock. The first or northernmost group comprises five tribes scattered among the mountain valleys from the region about the North Fork of San Joaquin River south to Eshom Valley, namely, Nim, Hol'-ko-mah, Ko-ko-he'-ba, Em-tim'-bitch and Wuk-să'-che. All of these are unquestionably of Paiute origin.

The second group lies much farther south, in the valley of South Fork of Kern, and thence southerly over Paiute Mountain to the neighborhood of Tehachapi, and comprises two tribes—the Pa-kan'-e-pul, on South Fork of Kern, and the New-oo'-ah, centering about Paiute Mountain. Their relations are not certain.

An examination of the languages of the Paiute tribes shows at once that they are by no means equally related either to one another or to the desert Indians from whom they originally came. The five northern tribes probably crossed the mountains in comparatively recent times, for their dialects differ only slightly from one another and from that of the Petonaquats or Owens Valley Paiutes. The two southern tribes, if really of Paiute origin, must have invaded the region in very ancient times, for their tongues differ so widely from one another and from the assumed parent stock that it is only by certain common roots

that their supposed affinities appear. In fact, apart from the numerals the resemblances are very slight and it may be possible that they indicate contact rather than relationship. Further study of these Indians is greatly needed. Their reference to the Paiute stock in the present paper is only provisional.

Contrasting the distribution of the Yokut tribes collectively with that of the five undoubted Paiute tribes of the same region, it appears that the Yokut inhabit the hot San Joaquin Valley (Lower Sonoran) and adjacent foothills (Upper Sonoran), while the Paiute tribes inhabit the cooler Ponderosa pine belt of the mountains (Transition zone). Excepting the Chukchancys, who have pushed a little way into the Ponderosa pines, none of the Yokut tribes reach higher than the Digger pine belt, and only three of them (Chuk-chan′-cy, Kosh-sho′-o and Cho-ki′-min-ah) reach high enough to come within this belt.

It would be convenient to speak of the linguistic families or stocks as 'nations'—as the Paiute nation, the Yokut nation, and so on—but such a designation would be incorrect, for the reason that nothing like political unity of the component tribes exists.

As well known to ethnologists, the names of linguistic stocks often present difficulties, and the names of tribes still greater difficulties. In cases where Indians have a stock name for themselves—as the desert Paiute and Shoshone; or a tribal name—as Wuksache, Wiktchumne, Chukchancy—there is no trouble, but in cases where they have no tribal name, and such cases are common, various complications arise.

Many tribes speak of themselves as THE PEOPLE, and in numerous instances their word for people has been adopted by ethnologists (and sometimes by themselves) in lieu of a tribal or stock name. Among the family names of this class are Midu, Muwa and Yokut; among the tribal names are Nim and New-oo′-ah, both meaning people—the first from *neum* or *nüm,* the last from *new′-ah.* In some cases a locative or place name is prefixed to the stock name to distinguish the tribe—as *Ahwanee* Muwa, *Chowchilla* Muwa, and so on. In the case of tribes having no definite name for themselves it is sometimes practicable to use the name given them by another tribe—for every tribe is sure to have a name in the language of its neighbor. Such names are often based on points of the compass, meaning *north people, south people,* and so on.

While the Yokuts have no common or stock name for themselves (Yokut being the word meaning 'people' in some, but not all, of the tribes), every tribe has a fixed and definite tribal name. In the case of the desert Paiutes the opposite condition prevails, for all the tribes use the stock name, while only a few have definite tribal names. Similarly, several of the Paiute tribes on the west slope of the Sierra appear to lack distinctive names for themselves; hence the names here given for them are provisional and tentative. The doubtful names are Nim, Holkoma, Pakanepul, and possibly also New-oo′-ah; the well-established names are Kokoheba, Emtimbitch, Wuksache. Of these, Kokoheba is a place name—the name of a village—which has come to be applied to the tribe.

C. HART MERRIAM.

## *SCIENTIFIC BOOKS.*

### THE CRYPTOGAMIC BOTANY OF THE HARRIMAN EXPEDITION.*

THE scientific results of the Harriman expedition to Alaska are beginning to be made public and the handsomely bound volume recently issued gives us the first of the three

* 'Harriman Alaska Expedition,' Volume V., 'Cryptogamic Botany.' New York, Doubleday, Page and Co. 1904. Pp. 404 and 44 plates.

botanical volumes promised, and includes the results of exploration in the field of the lowest plants. How little was hitherto known of some of the lower plants of this region is forcefully illustrated among the fungi, in which group only fifteen species had been definitely reported from Alaska prior to this publication. That there was no professional mycologist present with the expedition will account for the fact that only 252 species of fungi were collected by the members of the expedition or are reported for the first time in this volume. With conditions as favorable as those indicated in the introduction, the number collected might readily have been quadrupled, for a thousand species of fungi would be only an average collection to be picked up in almost any favorable locality, by a professional mycologist. Most of the species that were collected were due to the sharp eyes of Professor Trelease, who collected also most of the lichens, mosses and hepatics that were secured by the expedition. It is wholly reasonable to suppose that the results of the present expedition represent only from one eighth to one tenth of the entire fungus flora of Alaska when fully known, for we must realize that Alaska with its islands and peninsulas, if spread on the map of the rest of the United States with its upper corner at St. Paul, Minnesota, would extend from Savannah, Georgia, very nearly to Santa Barbara, California, and cover eight states and parts of a dozen more.

Among the fungi the new species are not excessive, amounting to thirty-eight, of which twenty-eight are by Saccardo or Saccardo and Scalia, five are by Trelease, one by Bresadola and four by Peck. By far the largest number are from the ascosporous series (including the *Fungi imperfecti*). The forty species of rusts form a smaller ratio to the whole than would naturally be expected. A useful host-index concludes the story of the fungi.

The 'Lichens of Alaska,' by Professor Clara E. Cummings, of Wellesley, occupies 82 pages, and includes a review of the work of previous collections from the region, so that the total of 462 species from Alaska doubtless represents more than half of the actual lichen flora of the region that complete exploration will ultimately make known. A most valuable addition to this part of the work is the series of keys to the species in each of the genera which clearly demonstrates the belief we have always held that, however much the early writers on American lichens struggled with a stilted and pedantic language to bury from view the easily discernible characters of the plants they described, lichens really possessed characters that could be easily tabulated when they were approached in a really rational way. The success with which the author has accomplished this is greatly to her credit and adds a most valuable feature to this portion of the book.

The part on the 'Algæ,' by Professor Saunders has already been published in advance of its appearance here, and is reprinted in the volume at hand with a careful preservation of the original pagination, so that citation from the original publication can be made from the present work with ease and accuracy. In the presence of so many lamentable failures on the part of editors to make this course possible, this feature is worthy of the highest commendation. The list contains 380 species of algæ, nearly two thirds of which were new to Alaska at the time of publication.

The 'Mosses of Alaska' also represents a reprint originally published in 1902 by Cardot and Theriot; 280 species are included. The hepatics by Professor Evans is also a reprint; the Harriman expedition nearly doubled the list in this group, the number of species now known from Alaska reaching 80.

The final portion of the work is by Professor Trelease and includes the ferns and fern allies. Seventy-four species are included in the list, which represents a large series when one considers so large an area belonging to a subarctic region, and yet when we consider that the central Californian 'golden-back' fern (*Ceropteris triangularis*) is found as far north as Cape Nome we are forced to the conclusion that there are climatic conditions existing in the Alaskan region that are favorable to the growth of plants of a much lower latitude as compared with other boreal parts of the earth. The plant figured as *Botrychium lunaria incisum* as 'new to Alaska' is quite typical

*B. boreale,* of which several collections have now been made from Alaska.

While the work as a whole would impress the average non-botanical reader as a list of plants merely, only those who have been engaged in distributional studies will understand the immense amount of careful and critical labor involved in the study of the material that underlies its preparation. It may be too early to form any general conclusions regarding the relations of the Alaskan flora, and it may be that the editors are expecting to include this in a later account in the two forthcoming volumes on the Spermatophytes which are expected 'in the early part of 1904,' but we are disappointed only in the absence of some more general discussion of the relations of the Alaskan flora to other regions.

The mechanical execution of the work is a great credit alike to the projector of the expedition, to the editors, and to the publishers. The heliotype plates are especially fine.

LUCIEN M. UNDERWOOD.

COLUMBIA UNIVERSITY,
May 19, 1904.

*The Eye, its Refraction and Diseases.* By EDWARD E. GIBBONS, M.D. 19 x 23 cm., pp. ix + 472, index. New York, The Macmillan Company; London, Macmillan & Co., Ltd. 1904.

The English-speaking student of ophthalmology whose special desire is to cultivate that subject as a useful art, has been much in need of a manual which should concern itself especially with the science of optics, geometrical and physiological, as applied in practise, such application being nowadays an important part of the daily routine work of the oculist.

A few years ago the elegant little 'Handbook' of Suter appeared, giving what was necessary in a geometrical line, and a short time after that Tcherning's 'Physiological Optics' was translated. Much of the subject matter of these two books necessarily enters into this volume of Dr. Gibbons, but much else has been included, sometimes in a cursory way, yet one finds here an excellent manual for the student or physician who thinks Landolt a little stiff for the first bout, and wishes the encouragement of the colloquial and sympathetic. If one expects in this volume any consideration of, or allusion to, the inflammatory affections with which text-books on 'Diseases of the Eye' are often almost exclusively concerned, he will be disappointed. Only by a liberal construction of the word disease to include refraction anomalies and muscular insufficiencies can the contents of the book be made to justify the title page. The author need not be censured for thus limiting his subject matter. Conditions of the art and of the market make it desirable that just this ground should be covered in very much this way. But the title of the book is misleading.

The first seventy-five pages are taken up with geometrical optics. In order to appreciate this part, one must know that the audience addressed is entirely made up of medical men, and that the subject matter of the address is purely mathematical. Young men who have ability and predilection for mathematics rarely choose medicine as a profession, and most physicians shy at any kind of a formula that can not be put up by a druggist. Yet a man who wishes to be an oculist finds, after six or eight years devoted to a science not particularly formal, that he is face to face with a well-developed mathematical specialty, and he is lucky if he remembers enough of his undergraduate work to help him through. An occasional one will regard this situation as refreshing—he will write the book. More will accept it with resignation, and ask for what they miscall a 'practical' knowledge of the subject, obtained by means of diagrams and illustrative cases with very little of the condensation and generalization attractive to the former. It is the delicate task of the author to give the reader all he needs of the one, and a little more than he thinks he needs of the other. The indispensable in this case is just so much of the theory of centered optical systems as will enable one to combine the three principal refracting surfaces of the eye with two others belonging to any spectacle lens that the patient may wish to wear, and to calculate the place of the cardinal points,

and the size of the images. The 'Dioptrische Untersuchungen' 'in words of one syllable' is hardly attainable, but that of it which is indispensable seems here to have been presented in the simplest possible manner. Systems are compounded and equivalent lenses calculated by the aid of Newton's formula, '$cc' = ff'$,' in which the principal foci of a system are used as coordinates from which conjugate foci are measured by a symmetrical notation. In this way a good working theory is obtained, and is so illustrated by examples chosen from the eye itself, that the student becomes familiar with the constants with which he will be subsequently concerned. Chapter V., the following, is on 'visual acuity.' From this on the science is not very much separated from the useful art by which it is likely to be applied in practise. Most of the subject matter which comes to us by or through Tcherning and Landolt appears here and is in general very well presented. The author does not hesitate to express an opinion of his own occasionally. Among other things he says the Morton ophthalmoscope is the best for refraction purposes, from which we judge the hole in the small mirror is made larger than it was in the earlier instruments. The horopter has been robbed of half its interest. This devilish contraption which kept Helmholtz awake nights and which lesser men have dodged as 'un problème de mathématiques assez compliqué et sans grand intérêt' floats in from somewhere this side of the Rocky Mountains bearing a brand new name and shrunk to nothing more or less than a toric surface. We prefer it with its old euphonious title and complicated contour.

Near two hundred pages of the book are taken up with normal and abnormal refraction. Included in this part is a chapter on optometers of some historic and theoretic interest; also a chapter on retinoscopy well presented. Retinoscopy is a *sine qua non* to a few men who paralyze all cases and do a rough-and-ready refraction practise among infirmary patients. But retinoscopy is also a necessary part of the modern oculist's equipment and deserves the space here given to it.

Dr. Gibbons in common with most other oculists thinks there is no place in the world for the 'refracting optician.' He does not devote much attention to his natural enemy, but he offers him no quarter. From a purely medical standpoint the oculist may have the best of the argument, but the refracting optician is abroad in the land and is not likely to be preached out of existence. There are economic conditions which contribute to his success and justify his claim to recognition.

It is of course quite proper that the author should give a list of cycloplegics and their peculiarities and the method of procedure to be adopted by those who habitually use them in the fitting of glasses. The number of such is so great that they can not be ignored, but why so many oculists still think it worth while to acquire the useless and irrelevant information that comes from fitting glasses to a paralyzed eye is hard to tell. It may be gathered from the text that the author thinks such a course should be the rule rather than the exception.

In the line of petty fault finding it might be said that Holmgren's color test is rather meagerly given, that the description of a Rochon prism is made to do duty for a Wollaston, that it is a little dogmatic to assert in an unqualified way that lens and vitreous opacities are caused by eye-strain. The algebra has suffered in one or two places from clerical errors, and the table at the top of page 386 seems to have been obtained empirically under conditions which, if well understood, have certainly not been accurately described.

The letter press is as good as could be desired. The illustrations that have been made for the book are excellent. Their number is greatly increased by those borrowed from the instrument-maker, whose courtesy serves a double purpose. On the whole the author, publisher and instrument-maker should be well satisfied with the accomplishment.

William S. Dennett.

New York City.

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## *SCIENTIFIC JOURNALS AND ARTICLES.*

The May number of the *Botanical Gazette* contains the following papers: Ethel Sargant has written concerning 'The Evolution of the

Monocotyledons,' the argument being in substance that which she contributed to a discussion of the subject at the Southport meeting of the British Association. It is claimed that the monocotyledons are descended from an ancestry with two cotyledons and that the single cotyledon which distinguishes them is a member formed by a fusion of the pair. Isabel S. Smith has studied 'The Nutrition of the Egg in *Zamia*,' showing that the so-called nuclei reported to pass through the jacket-cells into the egg are the ends of haustoria sent out by the cytoplasm of the egg into the jacket-cells. Mary E. Opperman has published 'A Contribution to the Life History of *Aster*,' in which she treats of the development of the embryo sac and fertilization. Among the interesting points is a discovery of an antipodal cell fusing as an egg and about to be fertilized. J. Cardot and I. Theriot publish their second paper on 'The New or Unrecorded Mosses of North America,' describing numerous new forms. B. E. Livingston writes on the 'Physical Properties of Bog Water,' and from tests he has made draws the conclusion that bog waters do not have an appreciably higher concentration of dissolved substances than do the streams and lakes of the same region. J. N. Rose publishes a biographical sketch with portrait of the late William M. Canby. Francis Ramaley publishes a short preliminary statement of 'The Anatomy of the Cotyledons' in Cruciferæ and Ranunculaceæ.

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## *SOCIETIES AND ACADEMIES.*

### THE GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 157th meeting, held on May 11, Mr. G. O. Smith presented a paper on 'Stratigraphic Problems in the Northern Cascades.'

In western Washington, the Eocene was characteristically an epoch of sedimentations, just as the Miocene was one of vulcanism. The Eocene sediments are economically important by reason of the coals of the Puget formation on the west slope of the Cascades, and of the Roslyn formation on the eastern slope.

Study of the Eocene formations has shown that the sediments were contributed from land areas possessing topographic diversity, and that most of the Eocene basins were neither permanent nor extensive. In the survey of the Snoqualmie quadrangle additional facts were collected concerning the relief of the pre-Eocene surface and the conditions of the Eocene sedimentation. Six Eocene formations were recognized and mapped—three being purely sedimentary and the others volcanic in part at least. The maps and sections of the folio which is in preparation will exhibit two main features; the importance of the present areas of pre-Eocene rocks as structural axes at the beginning of the Eocene, and the variability introduced into the Eocene section by the eruption of two distinct types of lava from different centers at different times. The structural axes in this region have a general northwest-southeast trend, which is paralleled by the trend of the pre-Eocene schistosity as well as the axes of post-Miocene folding and faulting and the later post-peneplain warping in the adjacent Ellensburg quadrangle.

The principal fact presented in this paper was that the present ridges of old schist and granite determined in large measure the boundaries of Eocene basins and retained their structural importance throughout the whole of the very eventful Tertiary period.

The next paper, by J. E. Spurr, was entitled, 'Faulting at Tonopah, Nevada.' In a small area, containing about six square miles, in which the most important mines and prospects are situated, the rocks are a complex of Tertiary volcanic rocks, lavas and tuffs, with a formation of lake-deposited white tuff beds. With the exception of some of the latest lavas, all these rocks have been violently and intricately faulted. The latest rocks are chiefly silicious rhyolite and silicious dacite volcanic necks, the plugs of late Tertiary volcanoes. The faults do not run into them, and the relations indicate that most of the faulting was accomplished before, during and immediately after the intrusion of the necks. The faulting is especially clustered around the dacitic necks, and examination of the fault blocks shows

that they have been noticeably dragged down along the contact of the individual necks, and that the whole later area of dacitic plugs is down-sunken in respect to the adjacent area. Thus while much of the faulting was due to the thrust of the intrusion of the necks, much of it accomplished a collapse and down-sinking around the volcanic centers, subsequent upon eruption.

On account of the extreme irregularity of the volcanic formations, due both to original irregularity and to constantly intervening erosion, it is impossible to project cross-sections underground; but in mines instructive opportunities to study vein faulting in three dimensions are offered. It is there seen that many veins are affected by intersecting systems of close-set faults, producing sometimes an intricacy almost defying analysis.

In the Wandering Boy mine, a vein is affected by two intersecting systems of faults, each system with a nearly uniform amount and direction of throw. The result of these systems is to produce a zigzag line of equal displacement, diagonal between the directions of the two systems, and the blocks are progressively down-thrown along these lines. The strike of the vein is fortuitously parallel with the trend of equal displacement, and the relation of the dip to the vertical displacement such that one offsets the other, so that drifts perpendicular to each other encounter continually fragments of the vein, which thus appears to occupy in this space a horizontal zone.

Mr. Cleveland Abbe, Jr., then presented 'The Historic-Economic Significance of the Fall Line of the Atlantic Slope.' The speaker endeavored in a few words to point out the rôle the Fall Line played in the life of the North American Indians living along its course, showing that it was marked by village sites and may have been used to define tribal boundaries.

The first European explorers probably never pushed as far inland as the falls of the rivers, and the earliest settlements also were made near the mouths of rivers and located on the coastal plain. Only after these settlements were well established did adventurers and pioneers go out from them to the more remote falls. It was also pointed out that the dates of founding settlements at the falls grow later and later from New Jersey to Alabama, presumably due to the increasing distances of those points from the coastal settlements.

The significance of the falls along the fall line for the industrial development of the bordering regions, and more especially the social and industrial changes which it is bringing about in the southeastern states, was also emphasized. This paper will be published in full in the *Journal of Geography.*

Alfred H. Brooks,
*Secretary.*

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 586th meeting was held May 7, 1904, Vice-President Abbe in the chair.

Mr. I. E. Fowle, Jr., presented some results of work at the Astrophysical Observatory on 'The Absorption of Water Vapor in the Infra-red Solar Spectrum.'

The quantitative investigation of the variation, due to atmospheric water vapor, of the transmissibility of our atmosphere to the incoming solar energy is the primary object of this paper. This transmissibility which decreases from band to band generally with increasing wave-length, although it increases with increasing wave-length in the separate bands themselves, is well expressed by a modification of Bouguer's formula, $e = e_0 a^{m(.23)\epsilon_0}$; $e_0$ and $e$ are the values of the solar energy of a particular wave-length before and after transmission though our atmosphere, $a$, the fractional transmission of a unit layer, $m$, the air mass traversed by the beam and $.23\varepsilon_0$ is the aqueous vapor in one air mass as given by Hann's general formula, $\varepsilon_0$ being the vapor pressure at the earth's surface. Aqueous vapor seems to have no general absorption between 0.7 and $2.0\,\mu$. Bouguer's formula implies the absorption by a given quantity of water in vapor as independent of its density.

Mr. S. T. Tamura then presented a condensed mathematical discussion of the problem of 'The Nocturnal Cooling of the Atmosphere.' The paper does not admit of a brief abstract.

Charles K. Wead,
*Secretary.*

## THE AMERICAN CHEMICAL SOCIETY.
### NEW YORK SECTION.

AT the eighth regular meeting of the season, held on May 6, at the Chemists Club, 108 West 55th Street, the following papers were presented:

*A Revision of the Atomic Weight of Beryllium.* C. L. PARSONS.

The paper opened with a summary of the previous determinations of the atomic weight, all of any importance having been made upon the tetra-hydrous sulphate. Following this the results of investigation upon the chloride and sulphate were given, in which it was shown that Arodejew's $BeCl_2 \cdot 4H_2O$ and Klatzo's $BeSO_4 \cdot 7H_2O$ do not exist—that the chloride is extremely difficult to obtain perfectly pure, and that the hydrous sulphates lose water so easily under different equilibrium conditions that they are not safe compounds for atomic weight data.

Determinations of the atomic weight were made upon carefully purified beryllium acetylacetonate and basic beryllium acetate. These compounds lend themselves with especial advantage to the determination of the atomic weight of beryllium as they contain no crystal water and are themselves readily crystallized and sublimed. This is especially true of the basic acetate—a compound peculiar to beryllium alone. Spectroscopic examinations of the residues made by Professor Charles A. Hutchins, of Bowdoin College, failed to detect any impurity. The average of seven analyses on the acetylacetonate and of nine on the basic acetate gave the result: Atomic weight—Be = 9.113.

Incidentally a new crystalline compound of beryllium chloride, ether, water and hydrochloric acid was described and it was shown that the black precipitate mentioned by Kress and Moralit, and which they evidently thought must contain a new substance, was a mixture of the sulphides of zinc and iron.

*The Dissociation of Lead Nitrate:* J. LIVINGSTON R. MORGAN.

Using the data of Baekeland (*J. Am. Chem. Soc.*, XXVI., 391–399), the author showed that at 357° C. the dissociation constant of the reaction $Pb(NO_3)_2 \rightleftarrows PbO + O + 2NO_2$ is 0.062 when the partial pressures in the application of the law of mass action,

$$\sqrt{p_o} \times p^2_{no_2} = \text{constant},$$

are given in meters of mercury. The presence of an excess of oxygen makes the reaction abnormal in that it favors the formation of oxygen-richer basic salts of lead; while nitrogen peroxide retains the equilibrium in the above form.

By aid of van't Hoff's formula it was also shown that at the average temperature of 262° C. the heat of dissociation is 579, the experimental value being 578 Ostwald calories. At higher temperatures the variation between calculated and observed values is great, pointing to the presence of other compounds possessing different heat values.

*The Action of Sulphuretted Hydrogen on Alkaline Solutions of Zinc Salts:* LEROY W. MCCAY.

Sulphuretted hydrogen precipitates from alkaline solutions of zinc salts zinc hydrosulphide which dissolves completely when the gas is allowed to bubble through the solution for some time. As, if sulphuretted hydrogen be passed into a solution of zinc acetate until all the zinc is precipitated as zinc sulphide, on adding a small amount of caustic alkali and again passing the current of sulphuretted hydrogen through the solution the zinc sulphide dissolves. The reaction is important, as it has a direct bearing on analysis (detection of zinc in the alkaline filtrate from manganese hydroxide). The solution soon becomes turbid from the separation of zinc sulphide. If the liquid be mixed with concentrated solution of the caustic alkalies, or with concentrated solutions of alkali salts, a white, slimy precipitate instantly separates out which contains all the zinc. It would seem that the oxygen and sulphur compounds of zinc are analogous and that corresponding to the alkali zincates there is a class of compounds which may be called the alkali sulphozincates.

*A New Separation of Thorium from Cerium, Lanthanum and Didymium:* Arthur C. Neish.

Many organic precipitants were tried, most of which are weak organic acids. Metanitrobenzoic acid was found to be the best and precipitated thorium quantitatively from a neutral aqueous solution of the nitrate, while cerium, lanthanum and didymium were not precipitated.

Tables were given showing the efficiency of the separation from mixtures of pure salts in the proportions usually found in monazite sands. Five monazite sands from Brazil and two from North Carolina were analyzed by the new method and the results compared with those obtained by the 'combination' and the fumaric acid methods.

The conclusions reached were:

1. Metanitrobenzoic acid precipitates thorium quantitatively as $Th(C_6H_4NO_2CO_2)_4$ from a neutral solution of the nitrate.

2. When the precipitation is repeated it affords a complete separation from cerium, lanthanum and didymium.

3. This method gives as good results in the analysis of monazite as does the 'combination' or fumaric acid method, and has the advantage in that it is shorter and offers no difficulties in precipitation or filtration, while the precipitant is not expensive and avoids the use of alcohol.

*A Crucible Charge for Gold and Silver in Zinc Ores:* E. J. Hall and E. Popper.

The well-known difficulties accompanying the scorification assay of zinc ores, such as the necessity of taking but a small portion for the assay, the constant attention required, etc., led to a series of experiments conducted with the hope of eliminating both the troubles inherent in any scorification as well as the special difficulties met with in the scorification of zinc blende. After various modifications of the usual crucible charges had been tried, the final charge decided upon was:

| | | |
|---|---|---|
| Ore .................. | ⅓ | A. T. |
| Soda Ash ............ | 1⅓ | A. T. |
| Litharge ............. | 25 | gms. |
| Borax Glass ........... | 20 | gms. |

This charge was tried on fourteen ores with results agreeing with or exceeding the best figures obtained by scorification. A few typical results follow:

| | Zinc. Percent. | Gold and Silver. Scorification. Ounces. | Crucible. Ounces. |
|---|---|---|---|
| A. | 8 | 42.50 | 42.54 |
| B. | 11.5 | 125.80 | 129.40 |
| C. | 27.5 | 135.80 | 139.35 |
| D. | 52 | 40.10 | 41.34 |

The charge is not applicable to ores containing more than 7 per cent. of copper. The proper temperature for fusion was found to be from 750°–775° C. and the time required in the furnace 35 minutes.

*A New Crucible Support:* W. E. Chamberlain.

Three pieces of pipestem are set radially in a metallic ring or in the sides of an asbestos-lined cylinder. The pipestem being movable, the points on which the crucible rests may be adjusted according to the size of the latter, and the position in which it is to be held.

*Note on Milk Analysis:* H. C. Sherman and A. W. Hahn.

The average results of many determinations of fat and specific gravity in cow's milk were shown and the following relations noted. Increasing richness in fat from 4.17 to 4.7 per cent. was accompanied by increasing specific gravity, but no corresponding increase of gravity was found as the fat content increased from 4.7 to 5.7 per cent. The percentage of solids not fat (calculated by Richmond's formula) rose with the fat content, though to a much smaller degree. The sum of the fat content and the lactometer reading has been proposed as a basis for the calculation of added water in cow's milk, with the claim that it is a more constant figure in normal milk than the percentage of solids-not-fat. According to the results presented, the solids-not-fat is the more constant figure of the two, and is, therefore, to be preferred as a criterion of watering or a basis for calculating the amount of water added.

H. C. Sherman,
*Secretary.*

THE ONONDAGA ACADEMY OF SCIENCES.

THE regular monthly meeting of the Onondaga Academy of Sciences was held March 17 in the rooms of the Historical Association in Syracuse. Mr. Guy Bailey discussed the subject of bird photography. He showed some admirable results of his work in this line. He discussed the nesting and others habits of many of our native birds.

THE April meeting of the academy was held jointly with the Onondaga Historical Association in the latter's rooms on the evening of April 20. Mr. J. S. Pennock, of the Solvay Process Company, addressed the meeting upon 'Alkali Industries.' The lecture was well illustrated with stereopticon views and dealt chiefly with the history of the Solvay process and of the Syracuse plant.

J. E. KIRKWOOD,
*Corresponding Secretary.*

THE NEBRASKA ACADEMY OF SCIENCES.

THE fourteenth annual meeting of the Nebraska Academy of Sciences was held at the University of Nebraska, Lincoln, on January 28 and 29, 1904, a goodly number of members being present and a most enjoyable and profitable program being presented.

The papers read were as follows:

*Stratigraphic Delineation of the Benton and Niobrara Formations of Nebraska:* G. E. CONDRA.

In northeastern Nebraska these two formations have been much confused, owing to the similarity in appearance of the chalk rock which occurs in each of the two layers, but a layer of Carlyle clay 200 feet in thickness on the average intervenes between them.

*The Fuel Value of the Common Cottonwood:* C. E. BESSEY.

Weight for weight, cottonwood has a higher fuel value than hickory, oak, or other woods ordinarily used for fuel, though, bulk for bulk, it is inferior. It also grows relatively more rapidly, so that for Nebraska it is a more valuable tree to plant for fuel than any other of the varieties used for that purpose.

*A Method of Preserving Insects:* A. A. TYLER.

*How nearly can Latitude and Time be found by Means of Shadows:* G. D. SWEZEY.

*Tests on Artificial Building Stone:* E. G. WOODRUFF.

*Hybridization of Oaks:* H. B. DUNCANSON.

*The Origin and Occurrence of Arikaree Quartzite:* G. E. CONDRA.

*The Fish Tape-worm, a Human Parasite new to Nebraska:* HENRY B. WARD.

Noticing the occurrence of the common fish tape-worm of Europe in persons emigrant from Russia.

*The Pronunciation of Scientific Names:* F. E. CLEMENTS.

*The Strength of Nebraska Timber:* G. R. CHATBURN.

Reviewing some recent tests made upon various Nebraska grown timbers in the course of an extensive investigation of the subject.

*New Species of Cladocera from Lake Erie:* CHARLES FORDYCE.

*A Summer's Botanizing at Bellevue, Nebraska:* A. A. TYLER.

*Building Stones of the Carboniferous of Southeastern Nebraska:* E. G. WOODRUFF.

The most important quarry was stated to be at Cedar Creek, from which forty to fifty carloads a day are shipped.

*The Status of the Botanical Survey:* F. E. CLEMENTS.

*Implement-making Materials of Nebraska Aborigines:* E. E. BLACKMAN.

*Cement Possibilities of Northern Nebraska:* G. E. CONDRA.

*Word-spectra and their Value as Tests of Authorship:* R. E. MORITZ.

*Variations in the Larval Amblystoma:* J. H. POWERS.

The causes of variation were traced on analyzing various types of variation, first, to a variable food supply, and second, to variation in habits.

*The Terraced Appearance of Tree Growth on the Missouri Flood-plain:* G. E. CONDRA.

*The Foresting of the Sand-hills of Nebraska:* C. E. BESSEY.

*Occurrence of Solifugae in Nebraska:* M. H. Swenk.

*Some Points on Dermatobia hominis* (illustrated): H. B. Ward.

The presidential address was delivered by Lawrence Bruner upon the subject, 'Migrations of Birds.'

The following officers were elected for the ensuing year:

*President*—Professor H. B. Duncanson, State Normal School, Peru.

*Vice-President*—Professor O. V. P. Stout, University of Nebraska, Lincoln.

*Secretary*—Dr. R. H. Wolcott, University of Nebraska, Lincoln.

*Treasurer*—Mr. A. E. Sheldon, Lincoln.

*Directors*—Professor J. H. Powers, Doane College, Crete; Professor G. R. Chatburn, University of Nebraska, Lincoln; Professor R. A. Emerson, University of Nebraska, Lincoln; Mr. I. S. Trostler, Omaha.

R. H. Wolcott,
*Secretary.*

## DISCUSSION AND CORRESPONDENCE.

### NAMATOGÆAN OR EPIGÆAN?

To the Editor of Science: I suppose every one who has had occasion to write of ecology has mentally grumbled because we have not in English a convenient short word to express what we mean when we say 'land and fresh water,' of mollusks or other invertebrates.

The German 'Binnen,' when translated into its English equivalent 'inland,' does not seem quite adequate, since the sense is rather 'away from the sea,' instead of 'not of the sea,' or 'of the land and its waters,' whether near or far from the coast.

'Land shells' seems to exclude the inhabitants of streams and pools.

Annoyed by the clumsy periphrasis which it has seemed necessary to use, I have spent some time in search for an expression, not already dedicated to some other purpose, which could be used in such cases.

*Epigœan* was at first thought of as suitable; its meaning, 'upon the earth' (earth being understood in the wide sense of land or continent), is not inappropriate, the sound is harmonious, and the word brief.

The only criticism which suggests itself is that there is nothing in the word directly implying the inclusion of the fresh-water forms.

*Gœa* was used by the Greeks for the land, in antithesis to *Thalassa,* the sea, but *Gœan* seems subject to the same criticism as *Epigœan,* while *Hydrogœan* would seem to imply inhabitants of the land-waters only and not both land and fresh water.

Many of the compounds of 'gæa' are inharmonious or too long to seem acceptable.

The Greek '*Nama,*' meaning spring, rivulet or stream (whence '*Namatodes,*' abounding in streams), seemed to offer a possible compound not too harsh or otherwise unsuitable. Would '*Namatogœan*' seem too cumbersome? I should be very glad to have suggestions from the readers of Science, some of whom may have in their inner consciousness at this moment the very term needed.

Wm. H. Dall.

Smithsonian Institution,
June 2, 1904.

### THE BLACKENING OF TEETH IN THE ORIENT.

To the Editor of Science: I do not find among my notes a good reference to the blackening of the teeth in the orient, as to the materials, utensils, motives and distribution. If you will give expression to my poverty, surely some one will help me out.

O. T. Mason.

### 'VEGETABLE BALLS.'

With regard to Professor Ganong's query on the above subject in Science, of April 8, 1904, the following reference is given in De Ioni's 'Sylloge Algarum,' Vol. IV., Section I. (1897). The reference occurs on p. iv of the Bibliography and reads: 'Barclay G—Algoid Lake-balls from South Mist—s. n. t., 8°, 1 plate.'

The reference is obviously very incomplete but it may possibly refer to 'The Scottish Naturalist' or its present continuation the 'Annals of Scottish Natural History.' South Mist is one of the Islands forming the Outer Hebrides.

J. Adams.

Royal College of Science, Dublin.

## SPECIAL ARTICLES.

### THE MECHANISM OF THE MONT PELÉE SPINE.

THE growth of the Mont Pelée spine is essentially an eruption of solid rock. Geologists are familiar with the eruption of solid material in the form of lapilli and dust, but the escape of lava in a continuous solid mass is a novel phenomenon. Naturally much interest is felt in its explanation, and the subject has been discussed by several geologists. So far as the literature has come to my attention, it has failed to include a factor which appears to me to be of prime importance, and I take the liberty, therefore, of contributing to the discussion, even though my knowledge of the Pelée eruptions is altogether at second-hand.

The phenomenon to be explained is the gradual issue of a column of rock several hundred feet in diameter and having the full cross-section of the throat of the volcano. This rock is so hot as to be incandescent, except the immediate exterior, which may be supposed to be cooled by contact with the air; but it clearly is not molten, for the mass as a whole is so rigid as to support its own weight with a height of more than 1,000 feet. While it grows by rising, its height is also reduced by the breaking away of fragments above. Allowing for this reduction, the total length of the extruded column has been estimated at 3,000 feet.

It seems to me quite clear that this process of extrusion is, properly speaking, volcanic eruption; that molten magma rising from some deep source undergoes a change of physical condition in the conduit, and is thereby enabled to issue in solid form. The process is so rapid as to preclude the hypothesis that solidification results from loss of heat by conduction. Even if surface water finds its way to the walls of the conduit, and is able there to cool the exterior part of the rising column, there can be no appreciable effect on the interior part of the column within the short time indicated by the history of the eruption. The suggestion that surface water is absorbed (as steam) by the lava and the lava is thereby cooled, encounters a double objection: (1) That rising lavas, undergoing relief from pressure, are in condition for discharging, instead of absorbing, gases; and (2) that the diffusion through the rising magma of water absorbed in the periphery of the conduit would require as much time as the cooling of the magma by conduction.

I ascribe the solidification, instead, to the escape of gases originally contained in the magma, that is, of gases contained before the magma rose in the conduit. Steam is assumed to be the principal gas; but the nature of the gas is not important to the mechanical theory. As the gas passes from the condition of absorption into the free condition, forming bubbles in the magma, it is greatly expanded, and this expansion consumes energy. The case is analogous to that of a body of air rising through the atmosphere and becoming cooler by reason of expansion. In that case the energy expended in the expansion is furnished by the heat of the air itself, and the result is a lowering of temperature. In the expansion of gas within the magma the energy is furnished by the heat of the magma, with the result that the magma is converted from a liquid to a solid condition. There may be other results from the withdrawal of heat from the magma. If its temperature was originally above the temperature of liquefaction then it may be cooled as well as solidified. Or the process may, perhaps, go somewhat beyond the accomplishment of solidification, and give to the solid a temperature slightly below the melting point. But all that is necessary to the hypothesis is that the withdrawal of heat from the lava suffices to change it from the liquid to the solid condition.

If this view is correct, then the remarkable feature of the process involved in the production of the Pelée spine is the arrest of the exclusion and expansion of the gas at the precise stage necessary for the solidification of the magma. Usually it either falls short or passes beyond; in the one case producing a liquid magma charged with bubbles; in the other bursting the solid vesicles and blowing their fragments into the air. The rarity with which the process is arrested at the completion of solidification is probably to be ascribed to the fact that it interacts on itself. The amount of gas which can be held in solution

by a particular magma depends chiefly on the pressure to which it is subject. (The influence of temperature is not important in the present connection.) As pressure is gradually relieved during eruption, more and more of the contained gas is discharged. When explosion of vesicles is once initiated at the top of the column it reduces the pressure on lower parts by carrying away some of the lava, and this loss of pressure in turn promotes the exclusion of the gas. If this view of the process is correct, the paroxysmal character of explosive volcanic eruption is strictly analogous to that of geyser eruption.

These theoretic considerations lead to the prediction that when the Pelée spine shall have become so cool as to permit of close inspection, its lava will be found to be porous. Porosity may, perhaps, not be accounted a verification of the theory, but the absence of vesicles would prove it untenable.

G. K. Gilbert.

Washington,
May 26, 1904.

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A SUGGESTIVE RELATION BETWEEN THE GRAVITATIONAL CONSTANT AND THE CONSTANTS OF THE ETHER.

The phenomena of radio-activity and the ionization of gases point so strongly toward the electrical constitution of matter, that the writer has made an attempt to connect the fundamental constant of gravitation with the electrical constants of the ether.

The result obtained is published with the hope that it may suggest to other physicists a more valuable extension.

The gravitational equation as ordinarily written is

$$F = k\frac{M, M^1}{r^2},$$

where $k$ is the gravitational constant and $M, M^1$ are the gravitating masses. The unit of mass is the gram. This is a purely arbitrary unit, so I have chosen a new unit of mass, which may be defined as follows: The unit of mass shall be that mass which is associated with one electromagnetic unit each of positive and negative electricity. This mass is considered to be made up of electrons, each of which has a definite mass associated with a definite amount of electricity.

The adoption of this unit of mass involves a change in the numerical value of the gravitational constant. The object of this paper is to investigate the value of this constant.

The ratio of the charge to the mass of an electron as well as the charge itself has been determined by direct experiment. The most probable value of the charge $e$ on an electron is $10^{-20}$ electromagnetic units, as measured by Mr. H. A. Wilson. The ratio $e/m$ has been measured by a number of physicists. The following are some of the best values found by experiment:

| | |
|---|---|
| Kaufmann (1898) | $1.86 \times 10^7$ |
| Simon (1899) | $1.865 \times 10^7$ |
| Lenard (1899) | $1.15 \times 10^7$ |
| Kaufmann (1901) | $1.31 \times 10^7$ |
| Wiechert (1899) | $1.42 \times 10^7$ |

The mean of the above values is $e/m = 1.52 \times 10^7$ electromagnetic units. This quantity as well as the charge $e$ is probably correct to one significant figure.

The charge $e$ as stated above is $10^{-20}$; hence the mass of an electron is $m = .65 \times 10^{-27}$ grams.

The number of electrons carrying one electro-magnetic unit of electricity is $10^{20}$; consequently the mass associated with one unit of negative electricity is $.65 \times 10^{-7}$ grams. Gravitating matter as we know it is neutral as regards charge. There must be present then an equal amount of positive electricity. The mass associated with this positive electricity will also be $.65 \times 10^{-7}$ grams; hence the total mass that is associated in the combination of one unit each of both electricities is $1.3 \times 10^{-7}$ grams.

This is the new unit of mass. The new gravitational constant may be found by substituting in the equation

$$F = k\frac{M, M^1}{r^2}.$$

The value of $k$ for gram unit of mass is $6,673 \times 10^{-11}$, from which

$$F = \frac{1}{9 \times 10^{20} r^2} = \frac{1}{(3 \times 10^{10})^2 r^2} = \frac{1}{h^2 r^2}.$$

The symbol $h$ is used because, although it is numerically equal to the ratio of the electrical units, it has not the dimensions of velocity.

The new gravitational equation may be written

$$F = C\frac{M, M^1}{r^2}.$$

The numerical value of $C$ is the reciprocal of the square of the velocity of light.

Putting

$$h = \frac{1}{\sqrt{C}}$$

we may compare it with the well-known relation

$$v = \frac{1}{\sqrt{\mu K}}.$$

On the electromagnetic system $\mu = 1$, so

$$v = \frac{1}{\sqrt{K}},$$

the above equation may be written

$$F = K\frac{M, M^1}{r^2},$$

where $K$ has the numerical value of the dielectric constant of the ether, but it is not a quantity of the same kind.

This rather remarkable relation between the gravitational constant and the constant of the ether is very suggestive. The only ratio $e/m$ that will give this result is the one above used. It is also the most probable experimental value.

It appears to me that this coincidence can hardly be accidental.

If mass is electromagnetic, then the unit of mass here used is the rational unit, and the constant of mass attraction might be expected to be related to the constants of the ether.

The above result not only suggests that matter is electrical in constitution, but that gravitational force is the same in kind if not in degree with electrical forces, and that they act in a common medium.

It may be interesting to point out the relative magnitudes of electrical and gravitational forces.

The gravitational force is

$$F = k\frac{M, M^1}{r^2},$$

and the electrical force between the electricities contained in the masses $M$, $M^1$ if they were set free is

$$f = \frac{1}{K}\frac{Q, Q^1}{r^2}.$$

From which the ratio of electrical to gravitational force is

$$\frac{1}{Kk} = (3 \times 10^{10})^4.$$

BERGEN DAVIS.

PHŒNIX PHYSICAL LABORATORY,
COLUMBIA UNIVERSITY,
May 28, 1904.

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## THE ROYAL COMMISSION ON TUBERCULOSIS.

THE commission consisting of Sir Michael Foster, M.P. (chairman), Professor G. S. Woodhead, Professor Sidney Martin, Professor McFadyean and Professor R. W. Boyce has presented an *ad interim* report. It says:

"After duly considering the matter, we came to the conclusion that it would be desirable not to begin the inquiry by taking evidence—that is to say, by collecting the opinions of others (though this might be desirable at a later stage), but to attack the problem laid before us by conducting experimental investigations of our own.

"The first line of inquiry upon which we entered may be stated as follows: What are the effects produced by introducing into the body of the bovine animal (calf, heifer, cow), either through the alimentary canal as food, or directly into the tissues by subcutaneous or other injection, tuberculous material of human origin, *i. e.*, material containing living tubercle bacilli obtained from various cases of tuberculous disease in human beings, and how far do these effects resemble or differ from the effects produced by introducing into the bovine animal, under conditions as similar as possible, tuberculous material of bovine origin, *i. e.*, material containing living tubercle bacilli obtained from cases of tuberculous disease in the cow, calf or ox?

"We have up to the present made use in the above inquiry of more than twenty different 'strains' of tuberculous material of human origin—that is to say, of material

taken from more than twenty cases of tuberculous disease in human beings, including sputum from phthisical patients and the diseased parts of the lungs in pulmonary tuberculosis, mesenteric glands in primary abdominal tuberculosis, tuberculous bronchial and cervical glands and tuberculous joints. We have compared the effects produced by these with the effects produced by several different strains of tuberculous material of bovine origin.

"In the case of seven of the above strains of human origin, the introduction of the human tuberculous material into cattle gave rise at once to acute tuberculosis, with the development of widespread disease in various organs of the body, such as the lungs, spleen, liver, lymphatic glands, etc. In some instances the disease was of remarkable severity.

"In the case of the remaining strains, the bovine animal into which the tuberculous material was first introduced was affected to a less extent. The tuberculous disease was either limited to the spot where the material was introduced (this occurred, however, in two instances only, and these at the very beginning of our inquiry), or spread to a variable extent from the seat of inoculation along the lymphatic glands, with, at most, the appearance of a very small amount of tubercle in such organs as the lungs and spleen. Yet tuberculous material taken from the bovine animal thus affected, and introduced successively into other bovine animals, or into guinea-pigs from which bovine animals were subsequently inoculated, has, up to the present, in the case of five of these remaining strains, ultimately given rise in the bovine animal to general tuberculosis of an intense character; and we are still carrying out observations in this direction.

"We have very carefully compared the disease thus set up in the bovine animal by material of human origin with that set up in the bovine animal by material of bovine origin, and so far we have found the one, both in its broad general features and in its finer histological details, to be identical with the other. We have so far failed to discover any character by which we could distinguish the one from the other; and our records contain accounts of the post-mortem examinations of bovine animals infected with tuberculous material of human origin which might be used as typical descriptions of ordinary bovine tuberculosis.

"The results which we have thus obtained are so striking that we have felt it our duty to make them known without further delay in the present interim report.

"We defer to a further report all narration of the details of our experiments (and we may say that up to the present time we have made use of more than two hundred bovine animals), as well as all discussions, including those dealing with the influence of dose and of individual as well as racial susceptibility, with questions of the specific virulence of the different strains of bacilli, with the relative activity of cultures of bacilli and of emulsions of tuberculous organs and tissues, and with other points. In that report we shall deal fully with all these matters, as well as with the question why our results differ from those of some other observers."

## *THE INTERNATIONAL ASSOCIATION OF ACADEMIES.*

As we have already noted, The International Association of Academies met in London, on May 24, 25, 26 and 27 under the presidency of Sir Michael Foster. From reports published in the London *Times,* we take the following details. Lord Reay was nominated vice-president and Dr. Diels, Professor Darboux, Count Balzani and Professor Bakhuysen were appointed honorary presidents.

A resolution was passed to the effect that the initiation of any new international organization, to be maintained by subventions from different states, demands careful previous examination into the value and objects of such organization, and that it is desirable that proposals to establish such organizations should be considered by the International Association of Academies before definite action is taken.

Professor Credner moved "That this meeting recognizes the great value of the International Catalogue of Scientific Literature, and the importance of aiding the work by

making its existence known, as well as of contributing to its efficiency and completeness by endeavoring to secure the indexing of scientific publications at the time of issue, in accordance with the plan adopted by the Royal Society." Lord Reay announced that the British Academy was taking steps to publish a similar catalogue for philology, and the other branches of learning not included among the sciences of nature.

M. Boutroux gave a brief account of the work completed and contemplated in connection with the preparation of a complete edition of the works of Leibniz. Professor Waldeyer presented, on behalf of the commission for investigating the anatomy of the brain, a report of the sitting of the committee of May 24. The report stated that a meeting had been held of the invited members of the central commission and of the seven special commissions for brain investigation, and that there were present members both of the central commission and of the special commissions. Professor Waldeyer was elected chairman in place of the late Professor His, of whose memory Mr. Cunningham spoke in warm terms.

Professor Fredericq presented the report of the late Professor Marey on the work of the Institut Marey, and moved the following resolution—"The International Association of Academies approves the nomination of MM. Lippmann, Amagat, Charles Richet, Blix, Einthoven, Grützner, Langendorff, Schenck, Athanasiu as new members of the Marey Institut. After having considered the report of the late Professor Marey, dated May 5, 1904, on the work of the institute, the association congratulates the committee of the Marey Institut in having obtained in France recognition as being of public utility, and thus secured the permanence of this international scientific organization. The association expresses its best wishes for the success of the scientific work undertaken at the institute."

Sir A. Geikie, on behalf of the International Geological Congress, moved the following resolution: "The International Association having received and considered a reference made to it by the International Geological Congress held at Vienna, 1903, resolves to ask the International Geodetic Association to take into consideration whether and (or) in what way it can undertake or promote international cooperation in the investigation of the following subjects: 'Precise determination of levels in mountain chains subject to earthquakes, with the view of ascertaining whether such chains are stable or are undergoing movements of elevation or depression.' 'Measurements of the value of gravity with the object, so far as geological questions are concerned, of throwing light on the internal distribution of masses in the earth, and on the rigidity or isostasy of the terrestrial crust.'"

The president proposed Vienna as the place of meeting of the next general assembly in 1907. The proposal was adopted unanimously.

## SCIENTIFIC NOTES AND NEWS.

AT the jubilee celebrations of the University of Wisconsin the degree of doctor of laws was conferred on a number of delegates, including Henry Prentiss Armsby, director of the Pennsylvania Agricultural Experiment Station; Thomas C. Chamberlin, professor of geology, University of Chicago; Professor W. G. Farlow, Harvard University; Dr. Daniel Coit Gilman, president of Carnegie Institution; the Hon. James Wilson, secretary of agriculture; Robert S. Woodward, dean of the faculty of pure science, Columbia University; F. P. Mall, professor of anatomy, Johns Hopkins University; E. L. Mark, Hersey professor of anatomy, Harvard University; Professor S. L. Penfield, professor of mineralogy, Sheffield Scientific School, Yale University.

THE Chemical Society of London has elected as foreign members Professor E. W. Morley, of the Western Reserve University; Professor F. W. Clarke, of the U. S. Geological Survey, and Professor A. H. Becquerel, Professor C. A. L. de Bruyn, Madame Curie and Professor C. T. Liebermann.

COLUMBIA UNIVERSITY has conferred its doctorate of science on Professor Hugo De Vries, the eminent botanist of the University of Amsterdam.

On May 28 the delegates to the International Association of Academies were divided into two groups, one of which visited Oxford and the other Cambridge, where honorary degrees were conferred. We have already noted the degrees conferred at Cambridge; the recipients of the D.Sc. degree at Oxford were Professor Flechsig, Leipzig; Professor E. Ehlers, Göttingen; M. A. Giard, Paris; Dr. Victor von Lang, Vienna; Professor H. Mohn, Christiania, and Professor H. Obersteiner, Vienna.

On June 22 Oxford will confer further doctorates of science as follows: The Hon. C. A. Parsons, St. John's College, Cambridge; M. Pierre Curie, professeur de physique générale de l'Ecole Municipale de Physique et de Chimie Industrielles; Sir W. S. Church, president of the Royal College of Physicians; Sir Andrew Noble; Sir William Crookes; Sir David Gill, astronomer royal, Cape of Good Hope; Sir John Murray; Professor Alfred Marshall, professor of political economy at Cambridge; Professor J. J. Thomson, Cavendish professor of experimental physics at Cambridge; Professor Horace Lamb, professor of mathematics, Victoria University of Manchester; Professor A. R. Forsyth, Sadlerian professor of pure mathematics at Cambridge; Professor Dewar, Jacksonian professor of experimental philosophy, Cambridge, Fullerian professor of chemistry in the Royal Institution; and Professor Larmor, secretary of the Royal Society, Lucasian professor of mathematics at Cambridge.

W. F. M. Goss, dean of the Schools of Engineering of Purdue University, has received the honorary degree of Doctor of Engineering from the University of Illinois.

Professor J. M. Van Vleck, who holds the chair of mathematics and astronomy at Wesleyan University and has been a member of the faculty for fifty-one years, has been made professor emeritus, and at his own request relieved from obligation of further service.

Medical exchanges state that on his return from America recently, Professor Ehrlich was presented with a portrait medallion, by a group of sixty-five pupils and co-workers. He has been given the title of privy councilor, and is entitled to write 'von' before his name. The occasion of the presentation was his fiftieth birthday, which occurred on May 15.

Professor Svante Arrhenius, of Stockholm, lectured before the Royal Institution, London, on June 3, on electrolytic dissociation. He sailed for America on the American liner *St. Louis* on June 11.

Professor Paul Hanus, of the Department of Education of Harvard University, will spend next year abroad.

Dr. Heinrich Ries, professor of economic geology in Cornell University, will spend the summer studying the clays of Wisconsin. Mr. F. L. Gallup of the senior class will accompany him as assistant.

Wm. W. Coblentz has been reappointed research assistant by the Carnegie Institution to continue his work on infra-red radiation at Cornell University.

Miss Rose Maria Logan, and Miss Mary J. Hogue, of the Women's College of Baltimore, have been awarded scholarships admitting them to tables at the Marine Laboratory, at Woods Hole, Mass., and Miss Mary Gillespie Webb and Miss Carrie S. Bird, to tables at the Brooklyn Institute of Arts and Sciences, Cold Spring Harbor, Long Island, N. Y.

*The British Medical Journal* states that Mr. T. J. Britten, formerly manager of the Wolhuter Gold Mines, has been awarded the first prize of £500 and the gold medal offered by the Transvaal Chamber of Mines for the best appliance for the prevention of miners' phthisis. The suggested remedy is damping the dust by means of a water jet while drilling is in progress and while the blasting is taking place.

Mlle. Joteyko, lecturer on psychology in the University of Brussels, has been elected vice-president of the Neurological Society of Belgium.

The eighty-seventh annual meeting of the Société helvétiques des sciences naturelles will be held at Winterhour from July 30 to August 2, under the presidency of Professor J. Weber.

DR. WILHELM REIN, professor of education in the University of Jena, has accepted an invitation to deliver two lectures before the University of Manchester. The university will confer on him the degree of Doctor of Letters.

A BRONZE statue of Dr. Benjamin Rush, given to the nation by the American Medical Association, was unveiled at Washington on June 11. The statue, which stands in the grounds of the U. S. Naval Museum, is of heroic size. It stands on a base of Indian limestone, on which are four bas-relief panels. The one in front bears the inscription, 'Dr. Benjamin Rush, Physician and Philanthropist. 1745–1813.' One panel bears crossed swords and a wreath and beneath is inscribed, 'Signer of the Declaration of Independence.' Another panel bears a scroll, a pen and wreath with the inscription, 'First American Alienist.' The remaining panel bears the staff of Mercury, and the quotation 'Studium Sine Calamo Somnium. Mr. Louis R. Metcalfe was the architect of the statue, Mr. R. Hinton Perry the sculptor, and J. W. Pacey the builder. The statue was presented by Dr. J. H. Musser, president of the American Medical Association, and accepted by President Roosevelt. An address in honor of Dr. Rush was given by Dr. J. C. Wilson, of Philadelphia.

WE learn from the *Journal of the American Medical Association* that the street at Nancy, where Liébeault lived until his death last February, has been named after him, and will be known henceforth as Rue du Docteur Liébeault. He was the founder of the Nancy school of hypnology, and was in his eighty-second year at the time of his death.

A BRONZE medallion portrait in memory of the late Professor Adamson was unveiled at the University of Manchester on June 3, Professor Sorley, of Cambridge, making the principal address.

MR. ROBERT MCLACHLAN, F.R.S., the well-known British entomologist, whose work has been more particularly on the neuroptera, died on May 23, at the age of sixty-seven years.

WE regret also to record the deaths of M. E. D. del Castilo, the botanist, and of Professor Amato Amati, an Italian writer on geography.

THE British Association for the Advancement of Science has been invited to meet in York in 1906.

THE Station for Experimental Evolution of the Department of Experimental Biology of the Carnegie Institution at Cold Spring Harbor, L. I., was formally opened on Saturday, June 11. An introductory address was made by Director C. B. Davenport and a historieal address by Mr. Walter R. T. Jones, of the Wawepex Society, which has presented land for the station. Dr. John S. Billings made an address of acceptance as chairman of the executive committee of the Carnegie Institution, and Dr. Franklin W. Hooper made an address of welcome on behalf of the biological laboratory of the Brooklyn Institute. The scientific address was made by Professor Hugo De Vries, director of the Botanical Gardens at Amsterdam.

WE learn from the London *Times* that a first report of the application of the Liverpool Cancer Research Fund, given by Mr. Sutton Timmis, as a memorial of his wife, has just been published. The fund consists of a sum of £10,000, of which an amount not exceeding £1,500 may be spent annually under the direction of a committee, the proceedings of which have been brought into close relation with the Liverpool Royal Infirmary and with the Liverpool University. In addition to a brief history of the establishment of the fund, and to a financial statement, the report contains an account, by the director of the research, Dr. Grünbaum, of the lines upon which it has been begun and will be continued. These are chiefly experimental, as it is felt that statistical and geographical inquiries may be more effectively undertaken by the London and German committees.

SOME further details are now announced in regard to the eighth International Geographic Congress, to be held in September, and for the first time in the United States. It will open at the Columbian University, Washing-

ton, on Thursday, September 8, an informal reception being held at the Hubbard Memorial Hall by President McGee of the National Geographic Society the evening before. Three days will be allotted to Washington; general meetings being held in the morning; sectional meetings and receptions and social gatherings in the afternoon. Mrs. Gardiner G. Hubbard will receive the Congress at 'Twin Oaks,' on Friday afteroon; the Smithsonian Institution on Saturday afternoon, and Commander Robert E. Peary, U. S. N., on Saturday evening. The Philadelphia Geographical Society will entertain the Congress on Monday, September 12, with field meeting and a reception; the American Geographical Society in New York on September 13 and 14, luncheon being served each day at the American Museum of Natural History; a trip up the Hudson will occupy September 15; a field meeting at Niagara Falls, September 16; Chicago will occupy September 17, and meetings on September 19, 20 and 21, will be held with the Congress of Arts and Science at St. Louis. A far west trip is planned after adjournment, and on return to Washington President Roosevelt will receive the members.

Mr. Ferrier, secretary of the Scottish Antarctic Expedition, has received and printed a letter from Mr. W. S. Bruce, the leader of the expedition, in which he says: "We have reached the southeastern extremity of the Weddell Sea, discovering there a great barrier of ice, part of the Antarctic Continent. We have gone 215 miles further south than last year, and 180 further than Ross in this part of the Antarctic regions. We got beset here in 74 S., 23 W., and were frozen in for a week, from the 7th to the 12th of March. When we got out by chance I thought it wisest not to proceed further in trying to get south and west, but to continue our program to the northeast. We sounded from here up to Gough Island and from Gough Island to the Cape, revolutionizing the map of the South American Ocean by finding relatively shallow where specially deep water was expected."

Reuter's Agency learns that the scientific expedition which left England in February under Lieutenant Boyd Alexander for the forest region between the West Coast and Lake Chad arrived in canoes at Ibi, 250 miles up the Binue River, in April. The expedition had two sectional steel boats, and other canoes with stores, etc., were following up the river. The explorers, all of whom were in good health, had already been making some collections on the Binue and intended landing at Ibi with a view to pushing north into Bauchi. It was intended that the boats should proceed further up to the Gongola River, whence they would be carried across to Yo, on Lake Chad. From the lake itself it was intended to strike to the eastward.

The American Chemical Society will, as we have already announced, hold its thirtieth general meeting at Providence, R. I., on June 21, 22 and 23. The hotel headquarters will be the Narragansett Hotel. On Tuesday, June 21, at 10:00 a.m., the first session of the meeting will be held in the lecture room of Rockefeller Hall, of Brown University. There will be an address of welcome by the president of Brown University, Dr. Wm. H. P. Faunce, followed by a response on behalf of the society by its president, Dr. A. A. Noyes. The remainder of the morning session will be devoted to the reading and discussion of papers. Arrangements for afternoon visits and excursions will be announced on the program of the meetings, or at the morning session. On Wednesday, at 9 a.m., a session for general business and the reading and discussion of papers will be held in the lecture room of Rockefeller Hall. A part of this session will be given to brief reports on researches which have been in progress in various universities and colleges during the past year. Such reports have already been promised from a number of institutions, and it is intended to make this a new and special feature of the meeting. Arrangements for afternoon visits and excursions will be announced on the program of the meetings, or at the morning session. On Thursday arrangements will be made for excursions and visits in addition to those planned for the other two days of the meeting.

A METEOROLOGICAL station of the U. S. Weather Bureau, under the charge of Mr. Alexander McC. Ashley, formerly local forecaster at Syracuse, N. Y., will be established at Honolulu.

IN response to a letter received from Mr. Calvin W. Rice, chairman of the American Institute of Electrical Engineers' Building Fund Committee, the executive committee of the Iowa State College branch of the institute appointed a local committee to solicit subscriptions from the local members and 'students' of the institute. The committee consists of Mr. B. S. Lanphear, chairman, Mr. G. W. Bissell and Mr. F. A. Pielsticker. The committee has been very successful, having raised about $700, with several of the local members yet to be interviewed. It is thought that the interest which has thus been aroused in institute matters will materially strengthen the local organization and thus eventually prove of even greater benefit to the local branch than to the institute building fund.

REUTER'S AGENCY reports that the Marconi wireless telegraph stations at Bari and Antivari (Montenegro) have now been erected for a month, and are in regular working order. Signor Marconi will personally open them in July next on his return to Italy. The high power station at Coltano (Pisa), near the royal farm of San Rossore, will be the largest in the world, and will be built entirely of stone. It will be ready in August or September, after which the engines and other apparatus will be installed, so that it may begin working not later than the beginning of 1905. The Coltano station will be able to communicate with Great Britain, Canada, the United States and the Netherlands, as well as with all vessels in the Mediterranean, the Baltic, the Red Sea, the Atlantic Ocean and the Indian Ocean. Signor Marconi has signed contracts with Chile and Argentina to construct telegraph stations.

REUTER'S Liverpool correspondent forwards information with regard to the Congo expedition which the Liverpool School of Tropical Medicine despatched to the Free State at the request of the King of the Belgians, for the purpose of studying trypanosomiasis, or sleeping sickness, in the autumn of 1903. The expedition consisted of Dr. J. E. Dutton and Dr. J. L. Todd, who formed the recent trypanosomiasis expedition of the school to Senegambia, and Dr. C. Christy, who was a member of the Royal Society's commission, sent to Uganda to study sleeping sickness. The expedition left England early in September last, and proceeded direct to Boma, where they stayed until the end of the year. At Boma the Belgian authorities attached a state medical officer, Dr. Heiberg, to the expedition, a step which was all the more appreciated from the fact that Dr. Heiberg was at one time a student at the Liverpool School of Tropical Medicine. After a stay of six weeks at Boma, the expedition proceeded to Matadi, where they remained for a few days. Dr. Dutton and Dr. Christy then went through the cataract region, their tour lasting three weeks, when they joined Dr. Todd and Dr. Heiberg, who had preceded them, at Leopoldsville. A long stay of over four months was made at Leopoldsville, where the government placed a spacious bungalow at the disposal of the expedition, and subsequently built a hospital for the special study by the expedition of sleeping sickness cases. Thanks to this the members were enabled to make careful observations, extending over several months, of sleeping sickness under the most favorable conditions possible, and to work without encountering the obstacles so frequently met with by expeditions in similar climes, who have not had the opportunity of remaining for a sufficient length of time in a suitable district under such favorable circumstances. As the cases of sickness were very numerous, a great amount of material was available, and the expedition were able to study closely all the different types of cases. Dr. Christy left for home on May 1, the other members, Dr. Todd and Dr. Dutton proceeding up the Congo River, where the expedition will continue their researches in the little-known regions of the interior. Their latest report was that they were in good health. Dr. Christy brought home with him to Europe by the *Anversville* three natives suffering

from trypanosomiasis, the disease generally known as sleeping sickness. It may be pointed out here that in a large percentage of cases in the Congo actual sleep is apparently not a marked feature in the progress of the disease. The work undertaken by the expedition has grown to very large dimensions, especially taking into consideration the expensive research being carried on in Liverpool in connection with the operations in the Congo. The work in the laboratories of the school in Liverpool consists of bacteriological and other investigations, which, owing to the lack of necessary apparatus, can not be adequately carried on in the Congo itself. The expenditure accordingly has already reached a very large sum, and the thanks of the scientific world are due to the King of the Belgians, Sir Alfred Jones, and other supporters of the Liverpool School of Tropical Medicine, whose generosity has up to the present made investigations on so large a scale possible.

## *UNIVERSITY AND EDUCATIONAL NEWS.*

The new medical laboratories of the University of Pennsylvania, erected at a cost of $700,000, were dedicated on June 10. The building was formally presented to the university by J. Vaughn Merrick, and accepted by Provost Charles C. Harrison.

New York University has purchased land adjoining the new college building on First Avenue, between Twenty-fifth and Twenty-sixth streets, and will proceed at once with the erection of a six-story fire-proof building for the clinics and laboratories of the Medical College.

The University of Michigan has established a statistical laboratory under Dr. James W. Glover, who has charge of the work in insurance.

The main building of the Rensselaer Polytechnic Institute, Troy, N. Y., was destroyed by fire on June 9. The loss is estimated at $100,000, the insurance being $53,000. Other fires have recently occurred at the institute, and they are supposed to be the work of an incendiary.

A Board of Anthropological Studies has been established at Cambridge, the studies under the direction of the board comprising prehistoric and historic anthropology and ethnology (including sociology and comparative religion), physical anthropology and psychological anthropology.

The University of London, with the cooperation of the Teachers' Guild of Great Britain and Ireland, will organize a four weeks' holiday course for foreigners, to be held in London this summer, from July 18 to August 12, with special arrangements for those who can not join till the end of July. Professor Rippman, of Queen's College, London, has been appointed director and Mr. Cloudesley Brereton will act as adviser to French students. The inaugural address will be given by Sir Arthur Rücker, principal of the university.

Dr. Thomas M. Balliet has resigned the superintendency of Public Schools of Springfield, Mass., a position he has filled for sixteen years, having accepted the deanship of the School of Pedagogy of New York University, his resignation to take effect September 1. In accepting his resignation the committee adopted a resolution of regret and at the same time congratulated the university which is to secure his services.

Professor Angelo Heilprin, of Philadelphia, late president of the Geographical Society of that city, has been appointed lecturer in physical geography in the Sheffield Scientific School of Yale University.

At the meeting of the Board of Regents of the University of Nebraska, on May 26, Dr. Thaddeus L. Bolton, assistant professor of philosophy was made professor of psychology.

At the June meeting of the regents of the University of Minnesota, Mr. E. W. D. Holway was appointed assistant professor in botany.

At Cambridge Mr. W. J. Sell and Mr. H. J. H. Fenton, of Christ's College, have been appointed university lecturers in chemistry, and Mr. A. Harker, of St. John's College, university lecturer in petrology.

# SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JUNE 24, 1904.

*CONTENTS:*



MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

## *THE ORGANIZATION AND WORK OF THE BUREAU OF STANDARDS.*

THE Bureau of Standards was organized July 1, 1901, as one of the Bureaus of the Treasury Department, and Professor S. W. Stratton, of the Chicago University, was appointed director. On July 1, 1903, it was transferred along with certain other bureaus to the newly established Department of Commerce and Labor.

The functions of the Bureau of Standards are briefly stated in the act of congress by which it was established. The bureau is to acquire and construct when necessary copies of the standards adopted or recognized by the government, their multiples and subdivisions; to make accurate comparisons with these standards of instruments and standards employed in scientific investigations, engineering, manufacturing, commerce and educational institutions; to conduct researches pertaining to precision measurements and to determine the physical constants and properties of materials. The bureau is also to furnish such information concerning standards, methods of measurement, physical constants and the properties of materials as may be at its disposal, and is authorized to exercise its functions for the government of the United States, for state or municipal governments, for scientific societies, educational institutions, corporations, firms or individuals, and although not expressly authorized in the act referred to, sometimes also serves foreign governments. No fees are collected for services performed for the national or state governments. From others a reasonable fee is charged, and a

new schedule of fees has recently been published.

To carry out these functions adequately requires large, well-equipped and fully manned physical and chemical laboratories. To this end congress has appropriated $25,000 for a site, $325,000 for two buildings and $225,000 for apparatus and equipment. It is expected that the buildings will be finished and their equipment of apparatus and machinery installed during the present year. These buildings have been so planned and located that additional buildings may be added as they become necessary.

In the meantime, while the work of planning and building laboratories and designing and constructing the somewhat extensive and in many respects unique equipment of the same has been going on, the bureau has been effecting its organization and developing its work in temporary quarters. When the Bureau of Standards was organized it superseded the office of Standard Weights and Measures and acquired its equipment; the old offices in the Coast and Geodetic Survey building were retained, and by the courtesy of the superintendent of the Coast and Geodetic Survey, several additional rooms provided in the adjoining building. A year later a neighboring residence was rented and converted into a laboratory and instrument shop. In the brick stable at the rear of the house a gas-engine and dynamo were installed for charging a storage battery, the latter being located in the laundry; the kitchen became the carpenter and cabinet shop; in another basement room were installed a switchboard and several motor-driven alternators. The parlor and dining-room were taken for an instrument shop, and here four mechanicians and two apprentices turned out some very important pieces of apparatus, in most cases, of course, of special design that could not be purchased already made. The three floors above have been occupied as laboratories.

In these very inadequate quarters the bureau has not only gathered together a considerable equipment of apparatus and done a great deal of preliminary work, but it has also done some testing for the government and the public and not a little research. The quantity of testing done has been limited partly by an insufficient force of assistants, partly by the incomplete equipment of apparatus and partly by lack of space in which to set up apparatus already at hand. It is the intention to undertake nothing in the line of testing that can not be done well. In some cases, however, instruments and standards submitted have necessarily been retained a considerable length of time. In every case, however, the bureau has striven to complete all tests requested as promptly as consistent with satisfactory results. During the present preparatory stage of the bureau the time required is often much greater than will be the case after the work is well established.

THE ORGANIZATION AND PERSONNEL.

The act establishing the bureau provided for fourteen positions at an aggregate salary of $27,140. The next year (1902–3) the number was increased to twenty-four at an aggregate salary of $36,060. For the present fiscal year there are altogether in the bureau fifty-eight positions at an aggregate salary of $74,700. These positions are as follows:

| | |
|---|---|
| One director, one physicist, one chemist...... | 3 |
| Eight assistant physicists, one assistant chemist ........ | 9 |
| Fifteen laboratory assistants, one librarian, one computer, one draftsman........ | 18 |
| One secretary, four clerks, two messengers, one storekeeper ........ | 8 |
| Four mechanicians, two woodworkers, three apprentices, two laborers........ | 11 |

One engineer, one assistant engineer, one electrician, two firemen, two watchmen, one janitor, one charwoman................ 9

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Thirteen additional positions will be available for the next fiscal year. All positions in the bureau are filled through the civil service commission, in many cases as the result of special civil service examinations. An erroneous idea is more or less prevalent that even scientific appointments in the government are made on the basis of personal or political influence. Nothing could be further from the fact. The officers of the bureau have been free from any such pressure and in every case they have striven to select the best man that was available for any given position. These positions are permanent, the civil service commission affording ample protection against loss of position without sufficient cause. Thus, while the interests of the government are protected on the one hand, the interests of the servants of the government are guarded on the other; and while the machinery of selection sometimes seems ponderous and appointments are often considerably delayed, it would be difficult to conceive other methods that would accomplish what the civil service actually does accomplish without equally serious objections of one kind or another.

For convenience of administration the bureau has been divided into three divisions. Division I. is under the personal charge of the director; Division II. is under the charge of the writer; and Division III. is under the charge of the chemist, Professor W. A. Noyes.

### DIVISION I.

Division I. comprises six sections, as follows:

1. *Weights and Measures,* under the charge of Mr. L. A. Fischer (Columbia University), who was for many years connected with the office of Standard Weights and Measures. He is assisted by L. G. Hoxton (University of Virginia), R. Y. Ferner (University of Wisconsin), N. S. Osborne (Michigan School of Mines) and L. L. Smith.

2. *Heat and Thermometry,* under the charge of Dr. C. W. Waidner (Johns Hopkins University), assisted by Dr. G. K. Burgess (M. I. T. and University of Paris) and Mr. H. C. Dickinson (Williams and Clark University).

3. *Light and Optical Instruments,* under the personal charge of the director, assisted by Dr. P. G. Nutting (University of California and Cornell) and Mr. F. J. Bates (University of Nebraska).

4. *Engineering Instruments,* under the charge of Mr. A. S. Merrill (M. I. T.).

5. *The Office,* under the charge of the secretary, Mr. Henry D. Hubbard (University of Chicago), assisted by Dr. J. R. Benton (Cornell), librarian, Mr. D. E. Douty (Clark University), storekeeper, four clerks and two messengers.

6. *The Instrument Shop,* with Mr. Oscar G. Lange, chief mechanician, and three other mechanicians and two apprentices, and the woodworking shop with two woodworkers.

### DIVISION II.

Division II. comprises six sections, as follows:

1. *Resistance and Electromotive Force,* under the charge of Dr. F. A. Wolff (Johns Hopkins University), assisted by Mr. F. E. Cady (Massachusetts Institute of Technology) and Dr. G. W. Middlekauf (Johns Hopkins University).

2. *Magnetism and Absolute Measurement of Current,* under the charge of Dr. K. E. Guthe (University of Marburg, University of Michigan).

3. *Inductance and Capacity,* under the personal charge of the physicist, assisted by Dr. N. E. Dorsey (Johns Hopkins Uni-

versity) and Mr. F. W. Grover (Massachusetts Institute of Technology and Wesleyan).

4. *Electrical Measuring Instruments,* also under the personal charge of the physicist, assisted by Dr. M. G. Lloyd (University of Pennsylvania), H. B. Brooks (Ohio State University), C. E. Reid (Purdue) and F. S. Durston (Wesleyan).

5. *Photometry,* under the charge of Mr. E. P. Hyde (Johns Hopkins University).

6. *Engineering Plant,* under the charge of the engineer, Mr. C. F. Sponsler (Pennsylvania State College).

#### DIVISION III.

Division III. comprises the chemical work of the bureau. At present the personnel of this division includes, besides the chemist, only the assistant chemist, Dr. H. N. Stokes (Johns Hopkins University). This work is relatively late in its organization, for the reason that the bureau has no place in which to develop a chemical laboratory. Plans are being matured the present fiscal year, and as soon as the new buildings are ready a complete chemical laboratory will be installed in one of them.

Through the courtesy of President Remsen, Professor Noyes is doing some work this year in the chemical laboratory of Johns Hopkins University; and through the courtesy of Dr. Wiley, of the agricultural department, Dr. Stokes is doing some work in the chemical laboratory of the bureau of chemistry. We expect to see some additions to the chemical force at the beginning of the next fiscal year.

#### THE VISITING COMMITTEE.

In naming the personnel of the bureau, I must not omit to include the visiting committee, constituted as follows: President Ira Remsen, Johns Hopkins University; President Henry S. Pritchett, Massachusetts Institute of Technology; Professor Edward L. Nichols, Cornell University; Professor Elihu Thomson, Lynn, Massachusetts; Mr. Albert Ladd Colby, Metallurgical Engineer, Bethlehem, Pennsylvania.

These gentlemen meet in Washington at least once each year, and after receiving a report from the director, make a thorough examination of the work of the bureau. On the basis of this examination they present a report to the secretary of commerce and labor, making such recommendations as they think proper. This committee has already been of much service to the bureau, and it is believed that it will also serve a valuable purpose as a medium of communication between the scientific public and the bureau.

The director of the Bureau of Standards renders an annual report and submits his estimates of the needs of the bureau to the secretary of commerce and labor. Through him congress receives these estimates and grants specific sums for buildings, for equipment, for current expenses and for salaries, after the director has appeared before the appropriations committees of both houses and explained in detail the needs of the bureau and the work to be carried on with the money appropriated.

#### THE SCIENTIFIC WORK.

The scientific work and testing which the bureau is doing at present or for which preparations are in progress may now be briefly stated.

#### DIVISION I.

Section 1. *Weights and Measures,* including the determination of lengths, masses and volumes.

The bureau possesses at the present time two iridio-platinum copies of the international meter, to which all lengths are referred, and apparatus for comparing other bars with them. One of these standards was taken to Paris last year by Mr.

Fischer and recompared with the standards of the international bureau.

It will be remembered that in 1893 congress adopted the international meter as the fundamental unit of length, continuing the ratio of the yard to the meter as 36 to 39.37. At the same time the international kilogram was adopted as the fundamental unit of mass. Thus the old standard yard of 1840 and the troy pound of the mint of 1827 were superseded, and hence all measures of length and mass in either metric or English system are now referred to the international meter and kilogram.

We are at present prepared to determine the length of any standard from 1 decimeter to 50 meters, and also to calibrate the subdivisions of such standards and to determine the coefficient of expansion of the same for ordinary ranges of temperature. The bureau is also prepared at the present time to compare base-measuring apparatus and steel tapes, but the facilities are such that the best results are only attained at the expense of great labor.

The tunnel connecting the physical and mechanical laboratories will be fitted out with facilities for comparing this kind of apparatus. This tunnel will be 170 feet long, 7 feet wide and 8 feet high, and facilities will be provided for comparing tapes up to 50 meters in length and to lay out a base of the same length with an error not greater than one part in two or three million, over which base-measuring apparatus may be tested. Means will also be provided for raising the temperature to, say, 40° Centigrade, and lowering to 10° C., for the determination of temperature coefficients of apparatus submitted.

The bureau possesses two iridio-platinum copies of the international kilogram and also the necessary working standards to verify masses from 0.1 milligram to 20 kilograms. The balances now on hand include a series of the best American makes and one precision balance similar to those found at the International Bureau of Weights and Measures. These are to be supplemented by other precision balances now being constructed, and when the physical building is completed and the balances installed the determination of masses within the above-named range may be made with the highest degree of accuracy.

The determination of the density of solids and of liquids is also part of the work of this section. Two sets of Jena glass hydrometers, graduated to read densities directly from 0.6 to 2.0, and verified at the Normal-Aichungs Kommission of Berlin, form part of the newer apparatus of this section.

Capacity measures from 1 milliliter to 40 liters are being standardized, and plans are being made to test various kinds of chemical measuring apparatus in large quantities.

Aneroid barometers are also tested by this section, employing the very convenient apparatus designed by Dr. Hebe of the Reichsanstalt and used at that institution.

The bureau has also been called upon to advise the officers of state and city sealers of weights and measures regarding the proper equipment of those officers and the methods to be pursued in performing their functions.

SECTION 2. *Thermometry and Pyrometry.*—Facilities have now been provided for the testing of mercurial thermometers in the interval − 30° C. to + 550° C. The testing of toluene, petroleum-ether and pentane thermometers, and copper constantan thermocouples for low temperature work, will be undertaken in the near future, the range extending down to about − 200° C.

The standard scale of temperature adopted by this bureau for work in the interval − 30° to + 100° C. is the scale of the hydrogen gas thermometer, as defined

by the resolutions of the committee of the International Bureau of Weights and Measures, dated October 15, 1887. (This scale has now come into world-wide use, and its general adoption in all important scientific and technical work has contributed toward the solution of important questions bearing on the mechanical equivalent of heat and the international electrical units.)

As primary standards the bureau now has fifteen Tonnelot and Baudin thermometers that have been carefully studied at the international bureau and which are now undergoing further intercomparison here.

As primary standards, in the interval 100° to 600° C., Dr. Waidner has had constructed some specially designed platinum resistance thermometers, both of the compensated and potential lead type, together with resistance bridges and other apparatus designed to afford the highest accuracy and convenience in working. He has chosen the platinum resistance thermometer as the primary standard of the bureau because it defines a scale of temperature that is at any time reproducible in any part of the world, and unlike most standard scales, it is not locked up in a few instruments that have been directly compared with the gas thermometer. As secondary and working standards in this interval, 100° C. to 550° C., the bureau has a number of mercury thermometers constructed of French hard glass and of Jena borosilicate (59‴) glass. Those intended for work above 300° C. have the space above the mercury filled with dry N or $CO_2$ gas under pressure. These mercurial standards are intercompared from time to time and occasionally they will be compared with the platinum resistance thermometers.

In the interval 0° C. to — 200° C. the standard scale of temperature is again that of the hydrogen-gas thermometer, and here also the platinum resistance thermometer serves to define the scale. For work in this range the resistance thermometer is, as before, referred to three known temperatures, viz., melting ice, melting $CO_2$, and the boiling point of liquid oxygen. As secondary and working standards in this interval, the bureau has a number of toluene thermometers, and copper-constantan thermocouples; and, in addition, some petroleum-ether and pentane thermometers, for use as low as — 180° C.

The scope of the testing work in this field, which is rapidly increasing, is already somewhat varied. It includes the certification of precision thermometers to be used in scientific work, the certification of standards used by some American thermometer makers, of thermometers used in important engineering tests, and of special types of mechanical thermometers used in industrial operations.

One branch of testing which promises to grow rapidly is the testing of clinical thermometers. Special apparatus has, therefore, been designed and constructed in the instrument shop of the bureau, to enable this work to be carried on with the greatest rapidity and precision. As an illustration of the results attained, it may be noted that 600 clinical thermometers can be read, at one temperature, in the space of 30 minutes.

Special facilities have been provided for high temperature testing, such as the standardization and testing of nearly all kinds of high temperature measuring instruments, including thermocouples, platinum resistance thermometers, expansion and optical pyrometers; the determination of the melting points of metals and alloys; the determination of the specific heats and coefficients of expansion at high temperature, etc.

Some of the apparatus has already been installed for the determination of the calorific value of fuels.

For carrying on this work the laboratory has been equipped with gas blast furnaces; electric furnaces which will maintain for hours temperatures as high as 1,400° or 1,500° C., constant to within a few degrees; electrically heated black bodies; and the necessary accessory apparatus, such as potentiometers, special resistance bridges, recording pyrometers, etc.

As primary standards for work in the interval 600° C. to 1,600° C., thermocouples obtained from various sources are used. These couples are referred to the scale of the nitrogen gas thermometer by measurement of their electromotive force at known temperatures, viz., the melting or freezing points of some of the metals.

The high temperature scale used by this bureau is based on the melting and freezing points of the metals as determined by Holborn and Day in their painstaking researches on the nitrogen gas thermometer. The scale is thus a reproduction of the high temperature scale used by the Physikalisch-Technische Reichsanstalt, and its adoption serves to extend the use of a uniform scale, which is always to be desired in physical measurements.

The establishment of our standard scales and the development of the apparatus required in testing have necessarily taken the greater part of the time since the establishment of the bureau. Research work has not, however, been neglected. The establishment of the standard scales has opened up a number of problems bearing on heat and temperature measurements, the investigation of which Dr. Waidner and Dr. Burgess have undertaken; this will form an important division of the work.

SECTION 3. *Light and Optical Instruments.*—The work of this section, which is under the personal charge of the director, has only recently been inaugurated, and it can not be fully developed until the second of the new buildings is occupied. Dr. Nutting is now carrying on some investigations on the electrical discharges in gases, to determine among other things the conditions necessary for producing a given spectrum by such a light source. Mr. Bates is making a careful study of polariscopic measurements, with special reference to the accurate determination of the percentage of pure sugar in a sample. The bureau has undertaken, at the request of the Treasury Department, to supervise the work of polariscopic analysis of sugar in all the custom houses of the country, and this is being done by Professor Noyes and Mr. Bates.

SECTION 4. *Engineering Instruments.*—The work to be undertaken in the near future in this section will include the testing of gas meters, water meters and pressure gauges, and testing the strength of materials, using for the latter work a 100,000-pound testing machine. Preparations for this work have only recently been begun, but the work is progressing rapidly. The range of the work will be extended beyond that indicated above as fast as possible.

DIVISION II.

*Section* 1. *Resistance and Electromotive Force.*—This work was begun by Dr. Wolff in the office of standard weights and measures several years before the Bureau of Standards was established. It was, therefore, the first section of the electrical work to do testing for the public and is now in a comparatively forward state of development. In addition to standard resistances and standard cells this laboratory also tests precision resistance boxes, Wheatstone bridges, potentiometers, precision shunts, etc. Specific resistances, temperature coefficients and thermo-electric properties of materials are also determined. A considerable part of the work of this section consists in the verification of apparatus of this kind for the other sections of the bureau.

For the present all resistance measurements of the bureau are referred to the mean of a number of one-ohm manganin standards which are reverified from time to time at the Physikalisch-Technische Reichsanstalt, and are, therefore, known in terms of the primary mercurial standards of that institution.

The construction of secondary mercurial standards, which after suitable aging change less than wire standards, has been begun and in time will be of service in fixing with the greatest possible accuracy the value of the one-ohm working standards. It is intended as soon as possible to construct a number of primary mercurial resistance standards. A supply of suitable Jena glass tubing has been secured, but the urgent demands upon the section for testing and the limited force available preclude this important piece of work for the present.

The set of manganin resistance standards of the bureau consists of ten one-ohm coils and four coils each of the following denominations: 10, 100, 1,000, 10,000, 100,000; .1, .01, .001, .0001, .00001, besides two two-ohm, three three-ohm, two five-ohm coils and two megohm boxes, this giving in most cases two reference standards and two working standards of each denomination.

Special efforts have been made to secure the accurate comparisons of the one-ohm coils with those of the other denominations, bearing the ratios of 1, 10, 100, etc. For this purpose as well as for the most accurate measurement of other resistances, Dr. Wolff designed and had constructed by Otto Wolff, of Berlin, a special mercury contact Wheatstone bridge of the Anthony form. For directly determining the ratio of two nearly equal coils Dr. Wolff had a special set of ratio coils and a four-dial shunt box constructed which enabled the ratio to be read off directly to parts in a million, the dials reading respectively .1 per cent., .01 per cent., .001 per cent. and .0001 per cent. Other special apparatus has been built or is under way for making precision measurements with a minimum of labor in the observations and computations.

The legal standard of electromotive force in the United States is the Clark cell, the value of which is 1.434 international volts at 15° C. and is, of course, the value used by the bureau. The Reichsanstalt uses a value nearly 0.1 per cent. smaller, namely, 1.4328. This unfortunate discrepancy can only be removed by further action of the next international congress followed by an act of congress if a change is authorized, fixing anew our legal standard. The value 1.433 is, perhaps, the nearest value that can be assigned from present data.

A considerable amount of testing has already been done by this section, chiefly resistance standards and resistance boxes, but including also a variety of other apparatus.

Section 2. *Magnetism and Absolute Measurement of Current.*—Preparations are under way for magnetic testing, but want of laboratory space has retarded the development of this work. Dr. Guthe is carrying on two important researches, namely, a study of the silver voltameter and a redetermination of the electrochemical equivalent of silver and of the absolute value of the Weston and Clark standard cells. A new absolute electrodynamometer is to be built for the latter investigation. The results of the investigation of the various forms of silver voltameters have recently been communicated to the American Physical Society. The magnetic laboratory is about to be established, and magnetic testing and research will be developed as rapidly as our limited force will permit.

Section 3. *Inductance and Capacity.*—A careful study of mica and paper con-

densers has been made, including the measurement of their capacities by different methods, the effect of time of charge upon their measured capacity, and the determination of absorption, leakage and temperature coefficients. Condensers have been purchased from various makers in England, France, Germany and America, and comparisons made with a view of determining the best performance to be obtained from both mica and paper condensers when used as measures of capacity. Some very interesting and valuable results have thus been obtained, although the work is not yet completed. Two large air condensers have recently been constructed to be used as standards. A new form of rotating commutator for use in determining capacities in absolute measure has recently been completed in our instrument shop and has been used in this work.

A considerable number of standards of inductance have been acquired and a great deal of work has been done in comparing inductances and determining their values absolutely. The bureau is now in a position to make accurate measures of both capacity and inductance and to compare and test condensers and inductance standards for the public.

Section 4. *Electrical Measuring Instruments.*—This section includes both alternating and direct current instruments (including instruments for measuring heavy current and high potential) except those precision instruments included in Section 1. Some testing of ammeters, voltmeters, wattmeters and watthour meters has been done for the public, but the principal work done so far has been preparatory. Many instruments have been purchased from the best instrument-makers at home and abroad, and other instruments have been designed and built in our own shop. Much of the apparatus purchased has been tested and in some cases altered and improved. Methods of measurement have been investigated, and a considerable experience acquired preparatory to the equipment of the laboratory for this work in the new building, to which this work has recently been transferred.

In addition to direct-current generators and storage batteries the following equipment of generators for alternating current has been acquired:

1. A small 120-cycle alternator, single-phase, suitable for voltmeter or condenser testing.

2. A three-phase 120-cycle alternator driven by an inverted rotary used as a motor and itself capable of giving a three-phase 60-cycle current.

3. A pair of 60-cycle three-phase revolving field alternators (direct-connected to a driving motor), of which one can have its armature rotated by a hand wheel while running, so that its current is displaced in one phase with respect to the other. Using one of these generators for the main current (which by use of transformers may be multiplied at reduced voltage) and the other for the potential current, any desired power factor may be obtained and wattmeters and watthour meters conveniently tested up to a capacity of 1,000 amperes and any desired voltage.

4. A pair of two-phase alternators, surface-wound and giving currents of nearly sine wave form (direct-connected to a driving motor), one alternator giving 60 cycles and the other 180, arranged so that the two armatures may be placed in series and the wave form varied through a considerable range by varying the magnitude and phase of the third harmonic. This is useful in studying the effects of varying wave form on the indications of measuring instruments of different kinds. For studying the effects of variations of frequency the speed can be varied through wide limits, and, for higher frequencies, the

higher frequency machine may be used alone. Transformers are arranged to change these two-phase currents to three-phase when desired.

5. Another three-machine set is under construction by the General Electric Co. This contains two 60-cycle three-phase alternators, with adjustable phase relation and surface windings, giving nearly sine wave form.

Special attention has been given to the matter of accurately measuring frequency, phase and wave form as well as alternating voltages, currents and power. These latter quantities are measured by means of instruments which admit of accurate calibration with direct currents and electromotive forces, the latter being measured by potentiometers, using standard resistances and Weston cells, the e.m.f. of the latter being of course known in terms of the standard Clark cells of the bureau. Thus all current, voltage and power measurements, both direct and alternating, are referred to standard resistances and standard cells.

The alternating instruments employed are as free as possible from errors due to inductance, eddy currents and capacity. Corrections are applied for the effects of small residual inductances when necessary. The alternating generators employed are driven by motors operated from storage batteries, enabling the speed and voltage to be maintained very uniform and measurements to be made with great precision. Thus frequency, voltage, power factor and wave form are controlled and varied as desired, and every effort is made to secure accurate measurements.

The bureau is now prepared to test alternating voltmeters, ammeters or dynamometers, wattmeters, watthour meters, phase and power factor meters, frequency indicators and other similar apparatus. Recently some very careful tests have been made on a lot of watthour meters to determine separately the effects of varying the voltage, frequency, power factor, temperature and wave form from the normal conditions, and of the load from 1 per cent. to 150 per cent. of normal full load, and curves plotted showing these several effects. As some of these effects were small, and as only one variable was altered at a time, very accurate measurements were required to determine the effects in question.

In the testing of direct-current instruments the bureau is now prepared to handle apparatus of capacities up to 1,000 amperes and 1,000 volts. A larger storage battery is being installed, which will give currents up to 5,000 amperes at 4 volts or 10,000 amperes at 2 volts, and a high potential battery of several thousand volts will be installed in the near future.

Section 5. *Photometry.*—One of the rooms of the temporary laboratory of the bureau was early assigned to photometric work, and an equipment of apparatus provided for measuring mean horizontal candle-power of incandescent lamps. The work was inaugurated by Dr. Wolff, but is now in charge of Mr. Hyde. As soon as the new buildings are occupied this equipment will be greatly augmented and the work enlarged. After doing considerable preliminary work the bureau is now prepared to test and certify incandescent lamps to be used as standards, and has already done this in a number of cases for manufacturers and others.

The Hefner amyl-acetate lamp has been somewhat generally accepted as a primary photometric standard, but its numerous defects make it quite unfit for a working standard. After taking the most elaborate precautions to maintain a steady and uniform flame, and applying corrections for the pressure and humidity of the air and its carbon dioxide content, the best results of the most skillful observers differ many

times more than in the comparisons of incandescent lamps of approximately equal efficiency with one another. Moreover, incandescent lamps suitably prepared and properly used are very permanent, and, being cheap and portable, may be duplicated and frequently tested. By keeping one set of lamps as reference standards and another as working standards, and burning them at relatively low temperatures (that is, at about four watts per candle) there is good reason for believing that the average value of a set of standards may be continued indefinitely.

A considerable number of electric standards have been obtained from the Reichsanstalt, the ratio of the candle to the Hefner unit being taken as 1 to .88. These reference standards are, of course, only occasionally used, and the mean of the value of several 16-candle power lamps is taken as the standard of the bureau. Exact copies of these will be added from time to time, so that of a change in any lamp is detected it may be discarded without impairing the completeness of the set. The current and voltage employed in testing lamps are measured by a potentiometer, and can be maintained constant to the hundredth of one per cent. Working by the substitution method, it is possible to make very accurate comparisons and thus to secure very exact copies of the standards of the bureau. The bureau recently requested a large number of lamp manufacturers to send each two or three carefully rated 16-candle power lamps for comparison with our standards. The lamps submitted varied from 15.4 to 17.6 candle power, averaging 16.48 cp., or about three per cent. high. Several of the large manufacturers were quite near to our standard, and it appears from these results that if all lamp manufacturers were to adopt the standards of the bureau there would be very little change in the average candle power of all the lamps manufactured, although some would be raised and others lowered. Since uniformity is extremely desirable and is now more easily attainable than heretofore, it is to be hoped that this result will speedily follow. The close agreement between the standards of the bureau and those of some of the manufacturers is due to the fact that the latter are using incandescent lamps rated at the Reichsanstalt. For the same reason, standards of the bureau are also in close agreement with those of the Lamp Testing Bureau of New York.

The purpose of the bureau is not to undertake, at least for the present, the commercial testing of incandescent lamps, but (apart from the testing done for the government) only to verify lamps to be used as standards and to make special investigations of lamps submitted for the purpose. To this end no effort will be spared to maintain reliable standards and to certify copies with the highest possible precision.

DIVISION III.

As already stated, the chemical division was late in being inaugurated. Aside from the immense assistance which a chemical laboratory can render to physical investigations, the division of chemistry will have important functions in its relations to the chemical interests of the country, and to the customs service and other departments of the government. Some chemical work is now being carried on, and detailed plans are being developed for the chemical laboratory to be installed in the larger of the two buildings now under construction.

THE EXPOSITION LABORATORY.

In addition to the exhibit which the bureau is making in the government building at St. Louis, it has undertaken, at the request of the authorities of the exposition, to install and operate an electrical testing laboratory in the electricity building dur-

ing the exposition. The work to be done will include the verification of measuring instruments to be used by the jury of awards in testing electrical machinery, and the testing for the jury of awards of instruments and apparatus submitted by exhibitors in competition. It is obvious that the intrinsic merits of a galvanometer, potentiometer, resistance standard, or other measuring instrument, can not be entirely determined by inspection, but only by rigorous test, and that a fully equipped testing laboratory can render important service to a jury of awards in the important and responsible duties which the latter is called upon to perform. A large exhibit of electrical instruments and machinery is expected from European manufacturers, more particularly from Germany, and without thoroughly testing the competing apparatus it would be impossible to distribute awards justly. It is proposed to publish the results of these tests so that they may be a permanent contribution to our knowledge of electrical instruments and machinery.

This laboratory is located along the east wall of the electricity building, south of the east entrance. The space assigned to it is nearly 200 feet long by 23 feet wide. A series of rooms have been constructed, all of which, except the office, are being equipped for laboratory purposes. A refrigerating machine having a capacity equivalent to the melting of ten tons of ice in twenty-four hours will be used in connection with the ventilating machinery and heat-regulating apparatus to control the temperature and humidity of the atmosphere in the laboratories. Piers and other substantial supports for apparatus have been installed and every effort is being made to provide the facilities and apparatus necessary to do precision testing.

In addition to doing the official testing for the jury of awards, testing for others will be done as far as practicable. For such work charges will be made according to the regular schedule of fees of the bureau. The laboratory will also serve as a working exhibit, and visitors will accordingly be admitted at certain specified times. For this reason, the exhibit of the bureau in the government building will be largely historical and educational and mainly devoted to subjects other than electricity.

### EQUIPMENT OF THE BUREAU.

Some account of the proposed equipment of the new laboratories of the bureau has been published* in connection with the plans of the buildings, consequently no attempt will here be made to describe again either the buildings or their general equipment, or to go into detail regarding the equipment for any particular line of work. The intention of the bureau is to provide every facility necessary for experimental work, both for research and testing, and to have a sufficient force of engineers, firemen, electricians and other assistants so that the service may be available at any or all times. The instrument shop is already well established, and the expectation is to have it so well manned that any of the various sectional laboratories can be promptly served whenever the work of testing or research makes the services of a mechanician necessary. To do this will require a considerable increase over the present force. Indeed, it is likely to be several years before the personnel will be so far increased as to meet urgent requirements. Notwithstanding the considerable force of men now at work, the bureau is seriously in need of more clerks, mechanicians and laboratory assistants; besides research workers and men to inaugurate new work, who are also much needed.

It is needless to emphasize further the importance of the highest standards in all

* Science, January 23, 1903.

the work of the bureau. Every new line of work taken up means a new research, and often the designing and building of a new series of instruments. As the limits of errors are narrowed the labor is rapidly augmented. What one man might do well in a day may require two men a week or a month if the accuracy is to be considerably increased. This will explain why the bureau has not already announced a greater range of testing, and why even when both the new buildings are occupied many lines of work will remain to be inaugurated.

It is the constant purpose of the bureau to cooperate with instrument makers and manufacturers to the end that their output of instruments and apparatus may be improved. Not simply to certify errors or criticize results, but to assist in perfecting the product, is the aim. In this work the bureau has so far enjoyed the confidence and cooperation of manufacturers to a gratifying degree. It was largely to meet their needs that the bureau was organized, and if by serving them the standard of excellence of American-made instruments and machinery is raised, the bureau will have served the public also. In several specific instances a marked improvement of this kind is already seen, due directly to the influence of the bureau of standards.

The advantage to scientific men and engineers of having a place in this country where instruments and standards may be verified with the highest possible precision, and at nominal charges, and where researches may be undertaken when necessary to answer questions arising in such comparisons, is evident. It greatly facilitates precision work both in engineering and in research.

The bureau has also fulfilled another of the functions mentioned in the act authorizing its establishment, in furnishing information on a variety of subjects included more or less closely in its field of activities. A considerable correspondence of this kind has grown up.

The functions of the Bureau of Standards are very broad and its possibilities for usefulness correspondingly great. It should do in its field, indeed, what the Coast Survey and the Geological Survey and the Department of Agriculture are doing in theirs, and what the Physikalisch-Technische Reichsanstalt and the Normal-Aichungs Kommission are doing in Germany. Fully to realize these possibilities will of course require a much further increase in equipment and in personnel, and this we expect to see.

EDWARD B. ROSA.
NATIONAL BUREAU OF STANDARDS.

## SCIENTIFIC BOOKS.

*Christian Faith in an Age of Science.* By WILLIAM NORTH RICE, Ph.D., LL.D., Professor of Geology in Wesleyan University. New York: A. C. Armstrong & Son. 1903. Pp. xi + 425.

As the author himself hints in his preface, it would not be difficult to cull some delightful antinomies from this work, and on a scale more extended than Dr. Rice suspects. At the same time, it was ever thus with books of the class. For example, I can picture the meaningful smile that would cross the faces of certain experts I could name, when they read those pronouncements: 'It is evident, in general, that we have in the book of Genesis nothing that approaches the character of reliable history till about the time of Abraham (p. 122); the Fourth Gospel is probably the only record by an eye-witness of the events connected with the resurrection' (p. 363). Similarly, in another field, when Dr. Rice suggests that the virgin birth and the resurrection—in the most usual acceptation of these terms—are essential to Christianity (p. 377), one is bound to refer him to the relative articles in 'The Encyclopædia Biblica.' In the same way, his naïve account of will would scarcely satisfy psychologists, while his fearfully and wonderfully made presentation of causality would amaze the thoroughly modern metaphysician.

But, even admitting these points, it would be a great mistake to dismiss the work thereupon. Its account of the progress of science, and of the resultant transformations wrought upon mediæval beliefs and whimsical suppositions, is very well done. Nay more, it marks a distinct advance over nearly all statements of the kind known to me. A few passages, culled at random, serve to prove this clearly: "The belief that the writers of the Bible were under the special influence and guidance of the Divine Spirit is a very different thing from the belief that their opinions were always just, their arguments always conclusive, or their knowledge of the facts always accurate" (p. 85). "We have come to regard as the main function of prophecy, not the construction of a map of all future history with symbols and names in cipher, but the presentation of warnings, consolations and moral exhortations, to reform or confirm the religious faith and life of the people addressed" (p. 106). "The conclusion which seems forced upon us is that no reconciliation between the geological record and that of Genesis is possible" (p. 111). "Apart from the dogma of the inerrancy of the Bible, the question of the date of the origin of man has obviously no theological significance whatsoever" (p. 117). "Wallace announced many years ago the remarkable proposition, that 'every species has come into existence coincident both in space and time with a preexisting closely allied species.' It would be impossible actually to prove that proposition in regard to every known species, since our knowledge of extinct life is so far from being complete. Nevertheless, the proposition can be shown to be true in so many instances that there is no reasonable doubt that it is to be accepted as a universal law. * * * The cumulative force of that evidence reveals itself only in prolonged study of some one or other of the departments of biology" (pp. 194–5, 198). "The theory of evolution is indeed the implacable foe of that sort of theistic philosophy which has been happily satirized in the phrase, 'the carpenter God'" (p. 254). "I can not escape the conviction that the tendency of evolutionary thought is decidedly towards monism" (p. 268). "It is difficult to see why that parallelism of ontogeny and phylogeny does not have the same significance in regard to psychical as in regard to physical characteristics" (p. 272). "The alternatives for the philosophical thinker seem to be dualism and monism, but with a third alternative of suspended judgment—agnosticism" (p. 275). "Neither volition nor any other mental state has a quantitative relation to physical energy. The recognition of the absolute disparateness of the two classes of phenomena is essential to sound thinking in regard to them" (p. 296). "The things which we can not predict we can pray for. The things which we can predict we can not pray for" (p. 346). "It is needless to say that no claim of certainty can be maintained in regard to Christianity as a system, or in regard to any particular doctrine of Christianity" (p. 406). All this is pretty well. These views, and others like them, are decidedly symptomatic.

Part I., which deals with science and its advance, will be of great service to many. Parts II. and III., which contain the philosophical, theological and religious considerations, can not be ranked in the same class. They are immensely weakened by absence of a transitive grasp upon first principles and, therefore, on the whole, they never really face the ultimate question, What are we *compelled* to infer to-day from man's knowledge of the physical universe, of the physiological body, and of the psychological organization? Yet, even at this, the book must be strongly commended to thousands who have hitherto been fed on mush, discreditable to its cooks and positively harmful to its consumers. For many babes Dr. Rice may prove strong meat, indeed. And from this point of view, his work deserves hearty recognition as a valuable installment, likely to carry advantageous weight in certain quarters.

R. M. W.

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## *SOCIETIES AND ACADEMIES.*

### THE NEW YORK ACADEMY OF SCIENCES.

### SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

THE regular meeting of the section was held April 25 at the American Museum of Natural

History in conjunction with the American Ethnological Society. The program was as follows:

*Notes on an Algonkin Dialect:* Dr. WM. JONES.

Dr. Jones presented a brief report on the method of word-formation of the Fox dialect. The dialect is Algonkin and belongs to the group now inhabiting, or that once inhabited, the country contiguous to Lake Huron, Lake Michigan and Lake Superior. Among the other dialects of the group are Ojibway, Ottawa, Pottawatomi, Menomonie, Kickapoo and Sauk. Morphologically all these dialects stand in an intimate relation with one another. The absolute forms of much of the vocabulary are the same, but varying differences in the way of intonation, articulation and grammar make some of the dialects seem somewhat removed from one another. Fox is nearest to Sauk and Kickapoo and farther removed from Ojibway.

The structural peculiarities of word-building as shown in the Fox would come out much the same in the other related dialects. The system of forming words is by composition. The elements entering into composition are formatives and stems. Some formatives are prefixes but most are suffixes. Some of the suffixes refer to the pronoun and gender in the same form. Stems fall into two general classes, initial and secondary. Initial stems come first in a combination and secondary stems come after. Secondary stems can be subdivided into at least two groups, one of a first order and another of a second order; the former stand next to initial stems, and the latter, when in composition, stand next to terminal pronouns.

The stems refer to general notions. Initial stems usually express subjective states and secondary stems generally refer to objective relations. The meaning of one stem modifies the meaning of another in a reciprocal manner with the result of greater specialization. Initial stems have greater extension and can often occur alone as adverbs.

A number of particles precede the terminal pronouns. The particles refer to causal relations. Some have the special office of instrumentality, as with the hand, foot, mouth, voice and ear.

The dialect makes a distinction between two opposing categories. Objects that have life and movement come in one class and objects without those attributes fall in another. The distinction is maintained with great vigor throughout the dialect; a force like personification sometimes interferes with it.

*On the Growth of Children:* Professor FRANZ BOAS and Dr. CLARK WISSLER.

Professor Franz Boas and Dr. Clark Wissler presented a joint paper on the growth of children, in which they discussed the causes of the increased variability during the period of growth. As the results of previous investigations, it had been suggested that the increased variability may be due to differences in the rapidity of development. The authors have followed out this line of investigation by collecting material regarding the variability of the period at which certain physiological changes take place. The times of dentition, the beginning of puberty, the appearance of the wisdom teeth, and the beginning of senility were selected for this purpose, and it was shown that the variability of time at which these phenomena take place increases with increasing age, and apparently the rate of increase of the variability is proportional to the age. Furthermore, it was shown that during the period of growth all the coefficients of correlation between the sizes of different parts of the body are increased. This can also be best explained by the theory that the phenomena of growth are largely due to acceleration and retardation.

*Paper-making Implements of Ancient Mexico* (with demonstration of specimens): Professor MARSHALL H. SAVILLE.

*The Grammar of the Yukaghir Language:* Mr. WALDEMAR JOCHELSON.

The paper reported the result of several years' study of the Yukaghir language, being mainly a sketch of the Kolyma dialect. There are two dialects in the language,—the Tundra dialect, and the Kolyma dialect. The phonetic and morphological peculiarities of the former are rather insignificant, but the Tundra dia-

lect has absorbed a considerable number of Tungus stems, which in their use in word-formation have been subjected to the rules of the Yukaghir grammar. These investigations show that the Yukaghir language stands isolated from the Siberian languages of the so-called Ural-Altaic group, and that it has many similarities to the languages of the American Indians.

The chief phonetic and morphological differences that distinguish the Yukaghir language from Ural-Altaic languages are the following: (1) It has not the intricate system of vowel harmony that is found in Ural-Altaic languages; (2) we do not find that the vowel of the root is unchangeable—an important rule in Ural-Altaic phonetics; (3) the Ural-Altaic possessive suffixes of nouns and verbs are wholly absent in Yukaghir verbs, and present in nouns only for the purpose of expressing ownership of the third person; (4) words are formed by means of suffixes and prefixes, while the Ural-Altaic languages use suffixes only.

The chief points of similarity between the Yukaghir language and Indian languages are: (1) The existence of a simple harmonic law in the use of vowels; (2) the use of prefixes; (3) adjectives are morphologically identical with verbal forms; (4) the verb-bases are mostly stems consisting of a single vowel or a small group of consonants, while the noun-bases are almost always derivatives of verbal forms; (5) the conjugation of transitive verbs is clearly distinguished from that of intransitive verbs; (6) transitive verbs may be changed into intransitive verbs by means of suffixes, and *vice versa;* (7) we find in the Yukaghir language the 'polysynthesis' of the American languages; (8) although there is not the actual 'incorporation' of the American languages, the syntactical construction of the Yukaghir sentence is akin to it.

James E. Lough,
*Secretary.*

## *DISCUSSION AND CORRESPONDENCE.*

### A FLYING MACHINE IN THE ARMY.

To the Editor of Science: In recent numbers of various journals, much has aptly been said about flying machines, balloons, aeroplanes, kites, aerodromes and mechanical means for navigating the air, with historical data, giving credit where credit is due and naming several of the great thinkers of the age and what they have done in this direction, with hints for the future, but not a word of what the army has done seems to have been printed.

For ages commanders in the field have desired to know what the enemy was doing. Hence the use of captive balloons and the wish to make them dirigible; and when the Astronomer General Mitchell commanded at Port Royal during the civil war, the matter was discussed with his chief engineer officer, who brought forward the proposition to make a *machine* without inflation, and exhibited a tin model that wound up with a string and a handle and spun like a humming top and would fly into the air a hundred feet or more, vertically, according to the force exerted upon it, and would carry a bullet or two if the string was pulled hard enough. From this little toy which was a circular disc of tin, so cut and bent as to make a fan-screw wheel, it was argued that with power enough, if it could be had within the necessary limit of weight, such fan propellers could be made and combined as to lift an observer into the air and by other horizontal propellers could be driven through the air, and by making one on a horizontal shaft so that the direction of its axis could be changed at will, the machine could be steered.

That it must have power to be driven faster than the wind moves was apparent or the wind would take it as it does a balloon. At that time balloons were very simple. No one had made progress in directing their flight.

Mitchell was a mechanician as well as a mathematician, and was proud of being able to measure the one ten-thousandth of an inch accurately, and he concluded that it would be well to consider the problem of air navigation without gas bags. But the yellow fever claimed him, and for a long time no more was done in that direction at department headquarters.

The Tenth Army Corps had a captive balloon, but it was of little use, except to excite

the wish that we had something better, and during the siege of Charleston Major Richard Butt and Captain James E. Place, of the engineers, and myself frequently discussed the details of a machine that should not only take up observers and go where we wished and come back, but carry bombs with high explosives to punish the enemy. The 'come back' part was of importance. The balloon would go, if the wind was right, but we had no way to make it come back as was wanted, hence it was never made to *go*.

The flight of birds was observed, buzzards, crows, eagles and gulls particularly. The machine must meet the requirements, to start, to go, to come back, to land safely—all were considered. There was no record that these questions had ever been before considered to be done mechanically, without gas. We considered gas-bag inflation as so objectionable as to be out of the question. Any machine held up by rarefied air or its equivalent presented so large a surface that power could not be had to drive it against the air, and unless it could go against the air quicker than the air itself moved, it was of no use for our purposes.

The ordnance department had tables of atmospheric velocities, so it was known what had to be encountered. During the siege of Charleston nothing was accomplished, but shortly after the Tenth Army Corps was moved up into Virginia and Petersburg was attacked, the means of finding out what the enemy was doing became a very prominent question with the engineers.

The tin toy was experimented with and a four-inch diameter fan was spun up to an elevation of over a hundred feet.

Major-General Benjamin F. Butler commanded the Army of the James and that included the tenth corps, and upon seeing what the tin toy did, immediately expressed the belief that a machine could be made that would navigate the air and give us the information desired, and could do more by dropping high explosives, and gave the writer an order to report officially upon the subject. No data could be found that gave any encouragement. The Duke of Argyle had organized a society in England, of which he was president, but except with gasholders to sustain the weight his society had done nothing. This society was communicated with, but before any reply was received drawings were made for a machine that should be screwed up and screwed forward, which if it could be made to ascend could be made to descend as slowly as desired, and it was to have planes by which to glide.

The theory was to imitate the little tin model and add to it gliding planes, and the drawings showed four fans to lift, two above an engine, two below, and two fans to propel and steer, one in front and one behind; the rear fan on a shaft that moved in a horizontal segment, so as to change the direction of the push, and make the rear fan not only a propeller, but a rudder at the same time. Across the machine was to be a horizontal shaft, on which on either side of the machine were to be gliding planes and automatic balancing balls. These were to slide in and out so as to maintain an equilibrium.

It had been observed that buzzards secured a vast amount of their progress by gliding, and the intention was to screw up and then glide in a descending curve, and by so doing save power, using the weight of the machine itself, and when the curve had come near enough to the earth, change the angle of the gliding planes, and by momentum go up as far as the impulse would aid in doing, using again at the same time the elevating screws. It was provided with a light supporting frame like the runners of a sleigh, on which to alight and to stand when at rest.

The body was to contain fuel and water and a high-pressure boiler and engine, and was to be shaped like a thick cigar. The length of the machine was about fifty-two feet, and from tip to tip of the gliding plane wings a little more. It was proposed to hang from the middle of the body a weight that could be lifted or lowered to act like the legs of a bird in flight and to balance it as the tail of a kite does. This vertically hanging weight was also to extend or draw in the balancing balls after the manner of the balancing pole used by the tight-rope walker.

It was argued that as a locomotive made to

walk on four legs, imitating a horse, was not a success, while the round leg as a wheel, acting continuously, was all that was wanted, so too the lifting and propelling fans, being intended for continuous motion, should do the work of wings and, better than reciprocating mechanical appliances, made to flap, condense the air, lift the body, release and flap again.

General Butler was so impressed when he saw the drawing and heard the explanation, that he ordered the machine to be built at once, and put the work in my charge.

There was, however, no appropriation that could be used to pay for it, and it seemed that nothing could be done; there was a very good engineer park, but the tools and machines at disposal were not fine enough to cut gear or to bore cylinders. Fortunately some patriotic citizens, who should be forever remembered, generously offered to pay the bills. Mr. Frederick Prentice, Mr. Wedworth W. Clarke, of New York City, and Mr. Sully, who were among the pioneers in the petroleum fields and were growing rich very fast, said: 'Send the bills to us; we will pay for anything wanted and will help to get it.'

The first thing done was to make a fan eighteen inches in diameter, rotate it at different speeds and see how much it would lift. The fan was made of very thin brass, and upon a wire frame, very much the same shape as those now used for ventilating and blowing, driven by electricity. It was found that a hollow blade with a blunt shoulder seemed to be best.

It was found that very considerable weight could be lifted, and to try what could be done on a large scale, a fan about thirty-two feet in diameter was made, the blades of the thinnest sheet iron that could be procured, and rotation by belt was provided.

Contrary to expectation, when the fan was first rotated at great speed in a foundry that had a high roof, the weight that could be lifted was much more than the wheel itself, some six hundred pounds or more, and then within forty seconds of time the wheel and the weights would drop back to where they started from, it mattered not how fast the fan was driven.

This was a puzzle, indeed. Why did it act so? When spun at a given speed, starting from at rest in still air, a certain velocity would make the wheel jump up the vertical shaft very quickly, lifting its own weight, and then suddenly, and as the velocity was increased, it would, after an interval never longer than forty seconds, slide down the vertical shaft, not sustaining its own weight. Hundreds saw it. The test was repeated again and again. No one understood why it did as it did.

Resort was then had again to the eighteen-inch brass wheel and it was found that after a certain period it went through the same manœuvers as the large fan, but the period of ability to lift was many times longer in the small than in the large.

It was found after a long investigation that the fan wheel of any size, when rotated in one place, set up a downward current of air that soon became nearly or quite as fast as the pitch of the fan, hence it would lift nothing. When, however, the fan was mounted at the outer end of a long boom, which revolved around a mast, so as to constantly bring the fan into new air, its lifting capacity never deserted it and bore a certain ratio to the velocity, and data were accumulated for proportioning the machine.

In those days there were no such machines as are now to be found everywhere, by which the horse power required at different velocities could readily be accurately measured, and some difficulty was experienced in approximating the requirements.

The questions involved seemed to be the size of the fan, the shape of the blade, the power required, the weight of the engine, boiler, fuel and water to develop the power.

Major-General Quincy A. Gillmore was an engineer officer of very high reputation and of considerable learning. He was asked to examine the plans and the data that had at this stage of the investigation been collected. He certified as a matter of opinion that it was 'all right.'

There were no dynamos or storage batteries, liquid air engines or sources of powerful energy using light-weight machines, and the only

prime motor sufficiently reliable was the steam-engine.

To get the strongest and the lightest was the problem.

It is true that carbonic acid had been liquefied some years before then, but no one knew how to harness it.

Having determined the probable force wanted, engine builders were found who agreed to make the engine light enough and of sufficient horse power, and the frame of the machine was set up at Hoboken, N. J. The fans were made for the lifting and driving, and the intermediate gear of bronze was cut. The body of the machine was complete.

At this stage it seemed that it only remained to get pressure enough upon the piston of the engine and maintain that pressure.

During the siege of Fort Wagner before Charleston we had used calcium lights, and had had great trouble to make the gas holders tight enough to prevent leak at high pressures. Mr. Mirriam, of Springfield, Mass., had succeeded in the field by a new method of floating the joints. Bennett and Risley, of Greenwich Street, New York, who undertook the engine, believed that they could make the joints of the boiler, the gaskets, the grummits and moving parts of the engine so as to work well under the required very high pressure of steam, by their new process, which seemed reasonable. Weeks, however, ran into months. They were unfortunate in their experiments, and the needed force of steam was not reached before the coming of Appomattox.

A description of the machine with a general and some detail drawings with tabulated data of the lifting capacity of the fans was filed with a rough model in the engineer department of the army at Washington, D. C., and a copy of the general plan was given to Mr. Prentice, whose office is now at 44 Broadway, New York City, and the Duke of Argyle was informed of what had in a general way been done by the army.

My conclusion was that at that time no existing machine would develop power enough to fly mechanically, without the use of gas-holders.

The use of liquid carbonic acid gas, $CO_2$, has changed the situation. Valves have been made to work well at great speed under three or four times the highest pressure of steam applied to reciprocating engines, and about five years ago a report was so made to the chief of engineers of the army.

The elimination of the boiler, water and fuel and the substitution of stored energy in the shape of liquid $CO_2$ greatly reduces the weight of machinery, and the conclusion reached at the last analysis of this problem is that for army use a radius of action of about eight hundred miles is now attainable, after some experimentation, as the chief difficulty, the valves, have already been tested to a success with pressures as high as are necessary.

Nothing is known by the writer of the details of the machinery recently tried by the brothers Wright in North Carolina, except that obtained from imperfect newspaper accounts, but from what has been published it would seem that their machine is very much like, if not identical, with the army machine here described; but whether this is so or not, they are to be most heartily congratulated upon the measure of success that has crowned their efforts, and this kind thought extends to my friend of years gone by—Chanute—who is reported to have helped them.

Edward Wellman Serrell.

West New Brighton,
Staten Island, N. Y.

### NOTES ON ANIMAL BEHAVIOR.

To the Editor of Science: It has been suggested to me that it would be worth while to put on record two or three rather curious instances of animal behavior which have come to my notice during the past few weeks. The subject of these observations is a two-year-old black-and-tan terrier belonging to my sister. A few weeks ago as the family was at dinner one evening my mother said, 'What did the postman bring this afternoon?' 'Only a couple of advertising cards,' said my sister, 'which I threw in the waste-basket.' Nothing more was said on the subject, but a moment later the dog, who had been sitting on a chair in the same room, ran to the basket and, taking one of the very cards referred to in his mouth,

ran around the table and stood with it beside my mother, looking up into her face and wagging his tail. I fear that some of our popular writers on animals would at once attribute a rather remarkable reasoning power to this dog, saying that he thought my mother would like to see the card, and so selecting it from the others in the basket took it to her and expected to be rewarded for his thoughtfulness. But there is a much more reasonable explanation. He is still very playful, and as he jumped from the chair and ran about the room the card projecting above the edge of the basket caught his eye, and the play instinct prompted him to seize it. The fact that he did this just after my sister had spoken of the card was a mere coincidence. His running to my mother with the card is easily explained. Several months ago, while he was still a puppy, in fact, he frequently pulled papers from this same basket and was punished for doing so, until he entirely gave up the habit. As soon as he had taken the card from the basket, the memory of former punishments for similar acts doubtless recurred to him. Now my mother is intensely sympathetic, and whenever he is punished or likely to be punished he invariably runs to her, knowing that he will be petted and may even get a lump of sugar; if the recollection of punishment came to him, he would naturally follow his habit and run to her.

It was about a week after this that my sister sat in the same dining room later in the evening reading a book, while the dog, who is as restless as dogs of that variety usually are, was running about looking for something to play with. At last my sister said, without looking up from her book and in an ordinary tone: 'Teddy, if you go down cellar and bring up a stick of wood, I'll play with you.' The dog stood beside her as she spoke and immediately darted out into the kitchen, down the stairs into the cellar and soon reappeared beside my sister with a stick of wood. This was not a trick that he had been taught. He has several times during the past winter carried sticks of wood from the cellar to the kitchen, and at times has been praised with such words as: 'Nice dog to bring up wood from the cellar.' But this carrying the wood has always been done voluntarily. Different members of the household when in the cellar have told him to carry up sticks, and he has never done so; sometimes a stick has been put in his mouth in the cellar, but after taking it as far as the stairs he would drop it and run up alone. He has been told a few times to go to the cellar and bring up a stick, but no attempt has been made to teach him to do so, and he has never done it except in the instance noted above. Since the evening in question the same remark has been made to him several times, and he has not responded to it in any way. The explanation would seem to be that he had learned to associate the words 'cellar' and 'stick' with the objects themselves and probably the word 'play' with the corresponding activity, for my sister plays with him a great deal and on such occasions frequently repeats the word 'play,' as 'Now let us play' or 'Come, play with your ball.' At the time in question the play instinct acted as a strong stimulus, probably a 'felt-need' from within, such as I have referred to in my text-book, and hence the special response. The whole act, then, involves no factors more complicated than memory and the association of names with objects, a faculty which dogs possess in considerable degree.

This same terrier, for example, associates the word 'ball' with the corresponding object with which he plays. If some one is in the pantry and you say to him, 'Go to the pantry and they will give you a piece of dog-biscuit,' he invariably goes for it, as he has doubtless learned to associate the words 'biscuit' and 'pantry' with the objects themselves. In the same way if you say to him, 'The grocer is coming into the kitchen to take orders; you must stay here in the dining room,' he invariably does so, although he is always very eager to see and jump upon any person who enters the house. The simple words, 'Grocer! stay here!' will have the same effect in keeping him out of the kitchen. He has likewise learned to associate the words, 'He is coming,' with the approach of any one to the house. I generally go home only on Sundays and at variable hours, and if the house is

quiet my mother sitting in the drawing room can say quite softly, 'I believe he is coming,' when the dog, two or three rooms distant and apparently asleep, will start up and run from window to window, looking up and down the street. He will do the same on any other day and for any individual, but with some variation in the rapidity of his response. I record these acts merely to show that while they might superficially appear to be the result of reasoning processes, they are doubtless only instances of memory and the association of spoken words with the objects or acts.

ARTHUR W. WEYSSE.

BOSTON, MASSACHUSETTS.

## *SPECIAL ARTICLES.*

### THE INHERITANCE OF SONG IN PASSERINE BIRDS.

### REMARKS ON THE DEVELOPMENT OF SONG IN THE ROSE-BREASTED GROSBEAK, ZAMELODIA LUDOVICIANA (LINNÆUS), AND THE MEADOW-LARK, STURNELLA MAGNA (LINNÆUS).

I AM tempted to elaborate at some length the life history of two broods of young birds that were raised in May and June, 1903, that definite data may be before the reader and student, as to exactly what has occurred for the past year with the individuals under observation.

On the 7th of June, 1903, I found a nest of rose-breasted grosbeaks in a swamp on the Millstone River, near Princeton. At the time of discovery the female was sitting, and presumably brooding new-laid eggs. She was not disturbed, but as I did not know when incubation had commenced, the locality was visited and observations were made at intervals of every other day, until on the 14th of the month I was assured that the young had been hatched. I was not then aware of the number of fledglings composing the brood. It seems worthy of record here that both parents took part in incubation, though the male only assumed such duty for brief periods, when the hen bird went away, probably for exercise and bathing, but not in quest of food. The male constantly fed the female and was solicitous in his care for her.

On the 14th of the month the young were hatched, and the parents shared the duties of brooding as they had shared the period of incubation. On the 19th of the month, concluding that the young were old enough for the experiment in view, I secured the nest, in which were a brood of three fledglings, and at once had a water-color sketch made of the young in the nest, as a record of their absolute condition, so far as feathering and appearance were concerned. While not able to discriminate with certainty the differentiation in sex, I was reasonably sure from the first that the brood contained two young male birds and one female.

On the 20th another accurate water-color sketch was made to record how these birds had grown and developed, and on the 21st a sketch of one of the birds, a male, for by this time the sexes were easily distinguishable, records his appearance from both a front and a back view.

These birds were carefully hand reared in the nest, which they left on the twenty-first inst., when about seven days old. Grosbeaks of this kind are very precocious, and being admirable climbers, they clamber about long before they are able to fly, on the limbs and tangle of vines which generally surround the nest.

It seems improbable that during the first four days of their lives these birds acquired much appreciation of the song of the male parent, though he was constantly singing close at hand.

The three young birds were successfully reared, and are alive at the present writing. The brood consisted, as I had anticipated from the first, of two males and one female. The birds were kept together for the first six or seven months of their lives, in a large cage, and as I had no other male grosbeak in my laboratory, it was, of course, quite impossible that they should have learned anything of the method of song of their ancestors, except such impression as may have been gathered during the first four days of their lives. All of them went through the regular moult, and assumed by September the characteristic dress of rose-breasted grosbeaks at that season of the year. In October the two young males both developed a change in appearance which progressed slowly

until near Christmas-time, when they began to appear like adult male grosbeaks in full spring plumage. I was not a little chagrined that during September and October they showed a disposition to quarrel and harass one another, so that many of the feathers of the tail were broken and ragged, and the birds presented a rather worn and torn plumage. My experience has been that with most passerine birds, the primary quills and the feathers of the tail are retained for the entire first year without change. I had, however, discovered that young Baltimore orioles moulted the rectrices during the months of January and February, and was, therefore, prepared for a similar moult in these grosbeaks, for I find that in very highly colored birds, while the primaries are not moulted during the first year, but attain their brilliancy either by wear or *by direct change in the color of the feather,* the tail feathers of such birds, at least in a number of species, are moulted. Any one who is familiar with the color pattern of the rectrices of adult Baltimore orioles and rose-breasted grosbeaks must be aware that there is a very strongly contrasted area of either black and yellow or black and white on most of the feathers. To emphasize the matter let me say again that Baltimore orioles and rose-breasted grosbeaks both moult their entire set of tail feathers during January and February, and acquire by this moult the distinctive color pattern which is characteristic of the adult bird.

In the case of my grosbeaks, with this moult of the rectrices they recovered rapidly their fine appearance, and are indistinguishable at the time I am writing from wild representatives of their kind out of doors. Therefore, my apprehension that they might not present a fine appearance was unwarranted, for the reason that I have fully explained.

With the primaries the change seems to be effected, so far as I have observed, in a different way, which I ascribe, as I have said before, partly to wear of the surface of each feather, but, besides this, *I am strongly inclined to the opinion that there is a physical change in the feather itself, which alters its appearance so far as color is concerned.*

The moult was about completed by the 10th of February, but previous to that time I had detected a slight motion of the throat and body, indicating that the two males were beginning to sing. At first it was hardly possible to detect anything but the faintest sounds, but in a week or ten days I could discriminate the song, which I shall describe as nearly as is possible, in words. The tone, on the whole, is extremely musical, and has the soft plaintive quality characteristic of the rose-breasted grosbeak. It is very melodious, and while the birds have continued to sing daily to the time of this writing, no one would refer the *method* of song to the bird in question. While it is fully as prolonged as the song of the rose-breasted grosbeak, as we know the bird out of doors, it has not nearly the volume, and is not so abruptly broken. The notes are low and flute-like and resemble strongly the kind of song one associates with robins and thrushes in the autumn or late summer for a short period, after they have completed the moult. I have had a number of competent observers listen to the performances of these birds on many occasions, and all agree with me that the song could not be referred to the rose-breasted grosbeak. It is true and entirely possible that later the birds may develop a more characteristic song, but inasmuch as the time approaches when wild rose-breasted grosbeaks make their advent in this vicinity, coming from their winter homes, I am inclined to believe that these birds have now acquired the song that will characterize them throughout the period of breeding. I may say that I have mated two of the birds, one of the young males and the female, and have secured an older female from another source, with which I have mated the other male bird. I trust that I may be able to report, later, successful efforts in breeding these birds in captivity, and further data concerning the method of song which may obtain amongst them. This finishes my remarks in regard to the rose-breasted grosbeaks, and I now propose to give some data in regard to meadowlarks, obtained about May 25, 1903.

I shall speak of the meadowlarks in a much more general way than of the grosbeaks, as

I have been unable to watch them as closely, for they have not been caged, but have been at large, first in a room by themselves until February, and later associated in another room with a number of meadowlarks that had been reared in previous years. I particularly wish to refer to one of the birds, a male which has arrested the attention of all observers.

In the same room with these larks there are three blackbirds, *Merula merula* (Linnæus), which I procured from Germany. All of these birds are males, and they sing chiefly late in the afternoon, but much more frequently during the night, especially when there is moonlight. Early in February I heard constantly what I supposed was the song of one of these blackbirds. The curious part of it was that only one measure of the song was produced, a silvery whistling sequence of five or six notes rather longer drawn out, and given with much precision. For several weeks I ascribed this to one of the blackbirds, and believed that because of the shelter afforded them by many evergreen trees in my bird room that it could only be this bird, though I was unable to see the singer while hearing the song. My friend, Mr. Horsfall, who was with me during all the time, checked my observations, but we neither of us were able to *locate* the songster.

One of my meadowlarks of the brood mentioned attracted our attenion by his behavior and deportment during the early part of April. In addition to his song, which was quite dissimilar to that of a wild meadowlark, he accompanied the performance by what I should call a parade or dance, analogous to the strut of the turkey-cock. It is so marked a characteristic of this and other individuals of the same species that I determined to have it recorded in a color sketch, and for two or three days Mr. Horsfall and I spent much time in getting the position and manner of the bird while occupied in this kind of behavior. The bird sang frequently while going through the manœuvre described, and both of us finally saw and heard him many times sing, preparatory to or after his own song, the cadence described, which I had referred, before I saw the meadowlark do it, to the European blackbird.

While I am fully aware that under the artificial conditions of confinement birds are extremely likely to acquire abnormal songs, I can not but feel that the knowledge of the methods of song which has come to me while watching birds under these conditions, indicate a receptivity which to some extent undoubtedly obtains in their lives out of doors. My conclusion is that birds are influenced in their early lives very strongly by any noise that arrests their attention, even in a wild state, and that this propensity to imitate and differentiate their normal methods of song is greatly exaggerated under the artificial state wherein they live when in confinement.

WILLIAM E. D. SCOTT.
DEPARTMENT OF ORNITHOLOGY,
PRINCETON UNIVERSITY,
April 30, 1904.

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STANDARD TESTS OF AUDITION.*

IN a recent publication from this laboratory,† tests for acuteness of hearing were divided into two classes: speech-tests, which employ letters, words or sentences, spoken aloud or whispered, and mechanical tests, which employ such apparatus as the watch, the tuning fork and the acoumeter. The existence and the common use of these two methods, for similar purposes, seem to be explained by the fact that each method possesses peculiar advantages, while neither is sufficiently free from serious defects to give it the whole field. The method that employs the voice measures directly the most important function of audition, the hearing of human speech, and it may, at the same time, be made sufficiently complex to cover a wide range of tone and noise; but, to offset this advantage, the method suffers from the great variability of the vocal stimulus. Mechanical tests, on the other hand, are simpler and are more easily standardized; but they do not—just because of their simplicity—furnish an adequate and reliable expression of general

* From the Psychological Laboratory of Cornell University.

† See 'Auditory Tests,' B. R. Andrews, *Amer. Journal of Psych.*, XV., 14.

auditory capacity. An individual who hears with difficulty ordinary conversation may, nevertheless, pass a fair examination with the watch tick or the tuning fork.

There is no doubt that human speech, could it be definitely controlled, would furnish the most adequate and the most comprehensive means of determining auditory acuity. But there has always been the difficulty of standardizing so complex and so variable a thing as the spoken word. This difficulty is serious; for although speech has been somewhat widely employed for this purpose by physicians, otologists and school and army examiners, the want of a common unit of measurement makes it impossible to compare the results obtained. The results have, in consequence, only a local interest.

The first important step toward standardization—the careful compilation of standard test series, composed of a like number of representative phonetic elements—was taken by Mr. Andrews,* who likewise proposed, in the article cited, an improved method of procedure.†

The object of this note is to suggest a still further advance in the perfection of the speech test. Instead of employing directly the voice of the investigator, and instead of relying upon acoustic and organic conditions which vary from experimenter to experimenter and from place to place, it proposes to use permanent phonographic records, which can be copied an indefinite number of times and can be reproduced independently of local conditions. The phonograph is especially available at present, because recent improvements in construction provide hard, durable cylinders which are copies of a single master record. Thus it should be possible to reproduce in any place and under constant conditions the same test series, inscribed upon a single cylinder by a single voice.

Through the courtesy of the National Phonograph Company the writer has been permitted to make preliminary records at the company's works in Orange. These records have since been subjected to trial on an Edison phonograph in the Cornell laboratory.

In reproducing the series of test words it is necessary, of course, to control both pitch and intensity of the sound. Pitch is easily controlled by setting the phonograph at the rate used in inscribing the record (*e. g.*, 100 revolutions a minute of the cylinder). Intensity is controlled in two ways: (1) constancy of intensity is obtained by the use of the new 'model C' reproducer (Edison), whose writing point is held in the wax groove by a constant pressure automatically provided; (2) reduction of intensity is obtained by a device set into the rubber transmission-tube. The reducing device consists of two telescoping brass cylinders 15 cm. long. The outer cylinder is 1 cm. in diameter and is perforated with 35 holes of 4 mm. diameter, running from end to end in a spiral pattern. The inner cylinder has closed walls. When the two are pushed in together they form, therefore, a closed section of the transmission-tube; but as they are drawn gradually apart more and more of the 35 holes are uncovered, allowing a greater and greater escape of the sound. When all the holes have been exposed only a small fraction of the sound reaches the ear; when all the holes are again covered the tube is completely closed. Intermediate settings of the reducer (made by scale readings on the inner brass cylinder) give a wider range of intensities. To increase the range still further, stops are inserted in the smaller cylinder. The writer used three of these stops; one entirely closed, one with a circular aperture of 0.5 mm., and one with an aperture of 3.0 mm. diameter. The tests thus far made indicate that only two of the stops will be required. To avoid direct transmission of the sound, through the air, it is necessary either to place the phonograph in a partially sound-proof box or to conduct the transmission-tube through a wall or the key hole of a tightly-fitting door to a second adjoining room. It is only necessary that no sound be heard by the subject when the ear tubes are inserted in the ears but disconnected from the instrument. Several individuals can be examined at once by duplicating the ear tubes or by substituting a megaphonic horn for the

* *L. c.*, pp. 29–36 (final table of test words on page 36).

† *L. c.*, pp. 53 ff.

tubes. Both of these devices involve, however, some sacrifice of accuracy to rapidity. Whisper as well as conversation records have been used in our trial series. But the conversation records promise to give a more delicate measure of hearing than the others, and may eventually supplant the whisper series, which have, after all, been employed heretofore chiefly because they demand less floor space than the more intensive sounds of vocal speech.

It is worth noting that the number-words of the test disappear, as their intensities are gradually diminished by the setting of the reducer, as quite clear and well-defined sounds and not as blurred masses—an important point in an examination of this kind. The tests thus far carried out have been made with original—not molded—records. Should a sufficient demand arise, however, permanent master records could be provided.

A possible objection to the method proposed is that the control of the stimulus words, as regards both their quality and their intensity, falls short of the ideals of pure psychophysical work; but, in anticipation of this objection, it may be said that anthropometrical tests of capacity demand an entirely different standard of accuracy from psychophysical researches proper. The method suggested offers such evident advantages—in simplicity as well as in accuracy—over traditional methods, that it has seemed worth while to bring it to general notice.

I. M. BENTLEY.

## QUOTATIONS.

### THE ATLANTIC CITY SESSION OF THE AMERICAN MEDICAL ASSOCIATION.

THE fifty-fifth annual session of the American Medical Association, held last week, was the most successful of any held in the history of the Association, not only in the number in attendance, but in the scientific work accomplished.

The attendance excelled that expected by the most hopeful. With the exception of one of the international medical congresses, it was probably the largest gathering of medical men ever held anywhere, the registration numbering 2,890. At the meeting in Atlantic City in 1900, 2,019 registered; at St. Paul in 1901, 1,806; at Saratoga Springs in 1902, 1,425; and at New Orleans in 1903, 2,006. Yet in spite of the number in attendance there was no evidence of crowding and no criticism in regard to accommodations. Atlantic City certainly proved herself capable of entertaining in a most satisfactory manner. The local committees of arrangement had done their work well, and are to be congratulated on the arrangements made and on the successful outcome of this magnificent meeting.

From a scientific point of view, no meeting ever surpassed it, whether we consider the meetings of special societies, international congresses, or what not. Every year some sections report having done very superior scientific work. This year from all the sections comes this report. It is not only the section officers and those especially interested in the sections who are saying this, but those who have never before taken an interest in the sections and who are more directly interested in other societies than in the sections of the American Medical Association are also acknowledging the superior scientific work at Atlantic City. The section officers deserve great credit for this result of their year's efforts. The officers of each section have vied with each other in trying to outdo what has been done in the past and to produce a program that should be superior scientifically to that of any preceding year and to that of any other special society. Those who know the amount of labor necessary to get up such a program and to make a section successful will appreciate that all the section officers have worked hard and have done their duty faithfully. They have all set standards for their successors that will be hard to surpass.

The symposia following the orations on Tuesday, Wednesday and Thursday evenings were something entirely new with this session, and they proved to be valuable as well as attractive. Never before have the general meetings been so well attended. The symposium on the first evening, which was devoted to a description of the research work that is being done in several institutions in this country,

was a revelation to those who did not know how much of this work was being done. The symposium on Wednesday evening, on the relation of the medical services of the Government to the profession, was also most interesting and instructive. Such a symposium tends to bring the profession and the services together as nothing else can. We all realize, to a certain extent at least, what the U. S. Public Health and Marine Hospital Service and the Medical Department of the Army have done and are doing, but we have been very unfamiliar with the work of the Medical Department of the Navy. Surgeon Stokes, in his part of the symposium, showed that the medical officer of the Navy has a wider field of usefulness than is usually supposed. The last symposium, that of Thursday evening, was also valuable and instructive, and brought to the attention of the profession other work that is being done by the government that is of special interest to medical men. While the building in which these meetings were held was a large one, standing room was at a premium on each occasion. President Musser deserves the thanks of the profession for having arranged for these symposia, and those who took part in them are also entitled to thanks for what they did to make them so successful.—*Journal of the American Medical Association.*

DEDICATION OF THE MEDICAL LABORATORIES OF THE UNIVERSITY OF PENNSYLVANIA.

The dedication of the new medical laboratories of the University of Pennsylvania, which took place on Friday, June 10, constitutes an epoch in medical education in America. The ceremonies were dignified and simple, and were attended by a large number of physicians, principally members of the American Medical Association that had accepted the courteous invitation extended to them by the university to be its guests. A special train brought the visitors from Atlantic City and took them back at night. To those that had not previously visited Philadelphia, as well as to the old graduates of Philadelphia's medical schools, their visit to the university must have been a revelation. Dr. Horatio Wood, in his eloquent address at the dedication of the new laboratories, alluded to the magnificent material progress that the university has made in the last generation—a progress, one may add, in which Dr. Wood has been an important factor. The new laboratories are intended for the departments of pathology, physiology and pharmacology, and everything has been done to give these important departments an ideal home. The building is architecturally attractive, and is in harmony with the general plan of the newer buildings, especially the dormitories. Mr. J. Vaughn Merrick, in the absence of Dr. S. Weir Mitchell, the chairman of the medical committee, delivered the presentation address, to which Provost Harrison responded. Dr. H. P. Bowditch, professor of physiology at Harvard University, spoke for physiology, and emphasized the importance of the physiologic laboratory in medical instruction, although he did not fail to say a good word for didactic teaching, which must still have a place in the medical curriculum. It should be borne in mind, he said, that it is quite as possible to abuse the laboratory as the didactic method of instruction; and that in all schemes of education a good teacher with a bad method is more effective than a bad teacher with a good method. Professor R. H. Chittenden, director of the Sheffield Scientific School of Yale University, dwelt upon the importance of physiologic chemistry to medicine, and illustrated it by describing the epoch-making work of Hoppe-Seyler and his school. Dr. George Dock, professor of medicine at the University of Michigan, decried the tendency to magnify the place of the laboratory, and to encourage students to do advanced original work before the foundation is laid. He also spoke of the neglect into which pathologic anatomy has fallen, and urged the importance of performing autopsies whenever possible. The difficulty in regard to autopsies does not depend upon public sentiment alone, but upon a certain neglect upon our own part. He thought that as pathology gets everywhere out of cellars and back rooms and has a local habitation like the new laboratories, its cultivation would assume a broader and more independent character. The laboratory building is quadrangular in shape, two stories in height

above a high basement, and measures 340 feet front by nearly 200 feet in depth. All along the front are arranged small rooms for research, rooms for the professors and assistants, a library, etc.; these open into a private corridor, so that the men employed in these rooms may pursue their work without interruption from students passing through the main halls. The second floor is devoted exclusively to pathology. The entire north front of the building is devoted to laboratories for advanced students in pathology and pathologic bacteriology, and to the special research and assistants' rooms.—*American Medicine.*

## *BOTANICAL NOTES.*

### ADIRONDACK PLANTS.

MRS. ANNIE MORRILL SMITH publishes in the 'Adirondack League Club Year Book' a corrected and enlarged list of plants found on the Adirondack League Club Tract, in which are enumerated 455 species, distributed as follows: Lichens, 29; hepatics, 40; mosses, 82; ferns and their allies, 27; conifers, 11; flowering plants, 266. The nomenclature of the higher plants is that of Britton's 'Manual.' The list has been reprinted in a neat twenty-page pamphlet. The botanists of the club are to be congratulated upon this evidence of their activity in the field.

### ALGAE IN WATER SUPPLIES.

GEORGE T. MOORE and Karl F. Kellerman, of the Division of Plant Physiology of the United States Department of Agriculture, have prepared a bulletin on the algae in water supplies which has been issued by the Bureau of Plant Industry (as No. 64). It appears that the investigation was first begun in order to find some cheap and practical method of preventing or removing the algal contamination of cress beds. This naturally extended to all cases of algal contamination of waters, including such growths in reservoirs in connection with water supplies for cities and towns. The importance of the matter is such that a preliminary publication is made in this bulletin in order that what has been found out as to preventives and remedies may be laid before boards of health and officers in charge of public water supplies.

It is here shown that 'it is entirely practicable to cheaply and quickly destroy objectionable algæ in small lakes, ponds, storage reservoirs and other similar bodies of water by the use of extremely dilute solutions of copper sulphate or of metallic copper.' Although copper sulphate is a poison it is to be used in such very dilute solutions as to render it harmless to man or other higher organisms. In the tests made in the cress beds it was possible to kill all of the algæ without injuring the cress, and still the solutions were so dilute that they were 'not considered injurious to man or other animals.'

The bulletin devotes some pages to the microscopical examination of drinking water, the wide distribution of trouble caused by algæ, the methods hitherto used for the abatement of the nuisance, the difficulties encountered, and then takes up the examination of the effects of various strengths of copper sulphate on different organisms. Among the organisms experimented with are *Chlamydomonas, Raphidium, Desmidium, Stigeoclonium, Draparnaldia, Navicula, Scenedesmus, Euglena, Spirogyra, Conferva, Closterium, Synura, Anabaena* and *Uroglena.* Some of these were killed in solutions as dilute as one part of copper sulphate to three million parts of water, while others endured solutions as strong as 1 to 2,000. It is evident that in order to apply this remedy the organisms must be fully known, and the authors emphasize the statement that it is impossible to tell what strength of solution to use without a thorough study of the organisms in any particular case. Incidentally they find that such treatment of the water supply is likely to destroy many pathogenic bacteria and also the larvae of mosquitoes.

### STRUCTURE OF THE PLANT NUCLEOLUS.

HAROLD WAGER discusses the structure of the nucleolus of the cells of the bean (*Phaseolus*) in the January number of the *Annals of Botany,* and concludes 'that not only is the nucleolus concerned in the formation of the chromosomes, but that there is a definite morphological connection between them.' He says further that "it is found that the nucle-

olus is intimately connected with the nuclear reticulum; that it contains nearly all the chromatin of the nucleus; that this is transferred, previous to division, into the nuclear thread, which is then segmented into chromosomes; and that in the reconstitution of the daughter-nuclei, the chromosomes become fused into a number of more or less spherical or irregular masses which unite to form the daughter nucleoli."

NUMBER OF POLLEN GRAINS IN INDIAN CORN.

In the *American Naturalist* for December, 1881, the writer published a note giving the results of a large number of careful counts and estimates made a few years earlier as to the number of pollen grains produced by Indian corn (maize). Briefly, the results were as follows: Average number of stamens in a 'tassel,' 7,200; average number of pollen grains in an anther, 2,500; average number of pollen grains produced by a plant, 18,000,000.

A recent bulletin (No. 77) prepared by Professor P. G. Holden, of the Iowa Experiment Station, gives considerably higher results, the statement being that "careful counts made at this station last year of the number of pollen grains found in an ordinary anther taken from different parts of a great many tassels showed that between 49,000,000 and 50,000,000 pollen grains were borne on an average by each tassel."

THE EARLY FALLING OF BOX-ELDER LEAVES.

Every one who has watched the box-elder tree (*Acer negundo*) carefully has noticed that the first leaves to appear in the spring are by no means typical, often being simple, but deeply cleft, so as to resemble those of the maples, and never having more than three leaflets when compound. These cataphyllary leaves occur on the first and second nodes of the shoots of the season, and even on the third and fourth in extreme cases, gradually approaching the typical five-foliate compound leaves. Within a fortnight of the appearance of the first leaves, and shortly after the typical leaves have developed the cataphylla begin falling from the trees. When this defoliation is at its maximum the ground under large trees is covered with the discarded leaves, much as in the autumn. This is so marked that it is one of the objections to this tree on lawns and well-kept grounds. Why these leaves are discarded so soon is not plain. We are reminded of the discarding of the primary leaves of the pines, where the matter has gone so far that none of the first crop of leaves are retained. The streets of Lincoln, Nebr., which have many box-elder trees planted along their sides, are now (May 21) littered with these fallen cataphyllary leaves.

PHILIPPINE PLANT NAMES.

On request of Captain G. P. Ahern, Chief of the Forestry Bureau of the Philippine Islands, the botanist of the bureau, Mr. Elmer D. Merrill, has prepared a very useful 'Dictionary of the Plant Names of the Philippine Islands,' which has been published at Manila by the Department of the Interior of the Islands. It consists of two parts, the first of which is an alphabetical list of the native names with the corresponding scientific names, while the second list includes an alphabetical arrangement of the genera and species, with native synonyms and short explanatory or descriptive notes. The extent of the undertaking may be inferred from the fact that between 4,500 and 5,000 native names are enumerated. And yet the author himself calls attention to the fact that the present enumeration records the native names for 'perhaps twelve to fifteen of the seventy or eighty dialects spoken in the archipelago.' There is evidently much more work of this kind to be done, and Mr. Merrill is entitled to much credit for the excellence of his list as far as he has carried it.

Charles E. Bessey.
The University of Nebraska.

## *EXPEDITION FOR SOLAR RESEARCH.*

With the aid of a grant of $10,000 from the Carnegie Institution, for use during the current year, the Yerkes Observatory of the University of Chicago has sent an expedition to Mt. Wilson (5,886 feet) near Pasadena, California, for the purpose of making special in-

vestigations of the sun. The principal instrument to be ercted on the mountain is the Snow horizontal telescope, recently constructed in the instrument and optical shops of the Yerkes Observatory as the result of a gift from Miss Helen Snow, of Chicago. This telescope is a cœlostat reflector, the cœlostat mirror having a diameter of 30 inches. A second plane mirror, 24 inches in diameter, reflects the beam north from the cœlostat to either one of two concave mirrors, each of 24 inch aperture. One of these concave mirrors, of about 60 feet focal length, is to be used in conjunction with a solar spectrograph of 5 inches aperture and 13 feet focal length; a spectroheliograph of 7 inches aperture, resembling the Rumford spectroheliograph of the Yerkes Observatory; and a stellar spectrograph provided with a large concave grating, and mounted in a constant temperature laboratory. It is hoped that it will be possible with this stellar spectrograph to photograph the spectra of a few of the brightest stars. For fainter stars, the spectrograph is to be provided with several prisms, for use singly or in combination.

The second concave mirror of the cœlostat reflector is designed to give a large focal image of the sun, especially adapted for investigations with a powerful spectroheliograph and for spectroscopic studies of sun-spots and other solar phenomena. The focal length of this mirror is about 145 feet, so that it will give a solar image about 16 inches in diameter. The spectroheliograph for use with this large solar image is to be of 7 inches aperture and 30 feet focal length. For the present, until a suitable grating can be obtained, the dispersive train of this instrument will consist of three prisms of 45° refracting angle, used in conjunction with a plane mirror, so as to give a total deviation of 180°. The motion of the solar image, of which a zone about 4 inches wide can be photographed with the spectroheliograph, will be produced by rotating the concave mirror about a vertical axis by means of a driving clock. A second driving clock, so controlled as to be synchronous with the first, will cause the photographic plate to move behind the second slit. Three slits will be provided at this point, so as to permit photographs to be taken simultaneously through as many different lines of the spectra. It is hoped that this spectroheliograph will prove to be well suited for use with some of the narrower dark lines of the solar spectrum.

The work of the expedition is under the immediate direction of Professor George E. Hale, director of the Yerkes Observatory. During his absence Professor E. B. Frost will be in immediate charge of the Yerkes Observatory, with the title of acting director. Professor Frost will also be the managing editor of the *Astrophysical Journal*. Mr. Ferdinand Ellerman and Mr. Walter S. Adams will be associated with Professor Hale in the work on Mt. Wilson.

Professor G. W. Ritchey, superintendent of instrument construction at the Yerkes Observatory, will be in charge of an instrument shop which is being fitted up for the expedition of Pasadena.

## *CARNEGIE INSTITUTION OF WASHINGTON.*

ON May 18, 1904, the trustees of the Carnegie Institution met, and after transacting the necessary business to provide for the transfer of all matters to the Carnegie Institution of Washington, a charter for which passed congress and was approved April 28, 1904, adjourned without day. The trustees named in the act met at once and reorganized under the new charter. The by-laws of the Carnegie Institution were adopted as the by-laws of the new organization, and the officers of the old organization were elected. General resolutions adopting all the obligations, etc., of the old institution were passed. Under the new charter no questions can be raised as to the competency of the institution to carry on the operations outlined in the deed of gift of the founder.

The executive committee of the Carnegie Institution of Washington met after the reorganization and practically completed the making of grants for the year 1904. It will greatly facilitate the work of the executive committee if all those thinking of making applications for grants for 1905 will have them in in September, as applications for grants for 1905 will then be taken up.

## SCIENTIFIC NOTES AND NEWS.

Dr. Louis S. McMurtry, of Louisville, Ky., has been elected president of the American Medical Association for the meeting to be held next year at Portland, Ore.

Professor George Darwin, of Cambridge, will succeed Mr. Balfour as president of the British Association, and will preside over the meeting to be held in South Africa next year.

Professor Simon Newcomb has been elected corresponding member of the Berlin Academy of Sciences.

At its meeting on June 9, the Geological Society of London elected Professor J. P. Iddings, of Chicago, as a foreign member, while Dr. W. Bullock Clark, of Baltimore, and Hon. Frank Springer, of East Las Vegas, New Mexico, were elected foreign correspondents.

M. Henri Moissan, the eminent French chemist, has been elected a corresponding member of the Academies of Sciences of Vienna and Amsterdam.

Dr. C. S. Sherrington, professor of physiology in the University of Liverpool, has been elected a member of the Imperial Academy of Medicine, Vienna.

The Vienna Academy of Sciences has awarded its Baumgarten prize, of the value of about $800, to Professor Walter Kaufmann for his investigations on the theory of electrons.

The Liebig gold medal for distinguished services in applied chemistry of the Association of German Chemists has been presented to Dr. Rudolf Knietsch, of the Badische Anilin und Soda-Fabrik, the discoverer of the contact process of sulphuric acid manufacture.

At the forty-fifth general meeting of the German Engineers' Association the Grashof medal, instituted in honor of the founder of the association, was unanimously conferred on the two pioneers of steam turbine propulsion, the Hon. C. A. Parsons, of Newcastle-on-Tyne, and M. de Laval, of Stockholm.

At its recent commencement exercises the University of Pennsylvania conferred the doctorate of science on Russell Henry Chittenden, professor of chemistry at Yale University, and George Dock, professor of theory and practise of medicine at the University of Michigan; and the doctorate of laws on Sir Frederick Treves, the British surgeon; Henry Pickering Bowditch, professor of physiology in Harvard Medical School, and Dr. H. C. Wood, professor of therapeutics, materia medica and pharmacy at the University of Pennsylvania.

Princeton University has conferred the degree of doctor of science on Dr. Per Dusen, the naturalist of Rio de Janeiro, and the degree of master of arts on Mr. Gifford Pinchot, chief of the Bureau of Forestry.

The new chemical laboratory of the University of Utrecht, named in honor of Professor J. H. van't Hoff, has been formally opened. On the occasion Professor van't Hoff was given the honorary doctorate by the university.

M. Barrois has been elected a member of the Paris Academy of Sciences in the section of mineralogy in the room of the late M. Fouqué.

Professor Bashford Dean, of Columbia University, will attend the International Zoological Congress at Bern, and will visit a number of European museums.

Dr. G. Cantor has celebrated the twenty-fifth anniversary of his professorship of mathematics at Halle.

Professor J. Volhard, director of the Chemical Laboratory of the University of Halle, celebrated on June 4 his seventieth birthday.

Mr. Santos-Dumont has arrived in this country with his dirigible balloon in which he will take part in the St. Louis aeronautic competition.

Professor J. J. Thomson, of Cambridge, delivered the Robert Boyle lecture in the hall of Balliol College, Oxford, on June 3, his subject being 'The Structure of the Atom.'

In connection with the meeting of the American Medical Association at Atlantic City, there was organized a National Association for the Study and Prevention of Tuberculosis. Dr. E. L. Trudeau, of Saranac Lake, N. Y., was elected president.

AN International Association to combat Tuberculosis was opened at Copenhagen on May 26. Among the delegates were Lord Lister from England and Professor Brouardel from France.

M. HAMY, assistant astronomer at the Paris Observatory, has been appointed astronomer in the room of the late M. Callandreau.

THE Jardin des Plantes, Paris, has received from M. Eugéne Potron a legacy of $10,000 for the erection of a statue in honor of Bernardine de St. Pierre, at one time director of the garden.

FOR a memorial of the late Dr. George Salmon, to be erected in St. Patrick's Cathedral, Dublin, the sum of £430 has been subscribed. The proposal to place within the precincts of Trinity College a memorial of the late provost has also been cordially received.

WE record with regret the death of M. Léauté Sarrau, professor of mechanics in the Polytechnic School of the University of Paris and member of the Paris Academy of Sciences, on May 10; of Dr. Fedor Bredichin, professor of astronomy at St. Petersburg, at the age of seventy-three years; of Dr. Adolfo Cancani, professor of terrestrial physics in the University of Modena; of Dr. Karl Bopp, professor of physics at the Stuttgart Polytechnic School; and of Dr. Max Kaech, who a few months since went from Bâsle to accept the position of chief of the Geological Institute at Para, Brazil, where he contracted yellow fever.

THE herbarium of the late Professor Marc Micheli has been presented to the town of Geneva by his widow.

THE act of congress making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1905, contains the following: "The Secretary of Agriculture is hereby directed to obtain in the open market samples of seeds of grass, clover, or alfalfa, test the same, and if any such seeds are found to be adulterated or misbranded, or any seeds of Canada bluegrass (*Poa compressa*) are obtained under any other name than Canada bluegrass or *Poa compressa,* to publish the results of the tests, together with the names of the persons by whom the seeds were offered for sale." Announcement is made that the collection and testing of seeds as directed by this act will begin July 1, 1904.

WE learn from the London *Times* that only two days before the death of the late Mr. Jamsetjee N. Tata the government of India issued a *communiqué* to the press describing as 'absolutely without foundation' the assertion of certain newspapers that Mr. Tata's offer of property valued at £200,000 towards founding an institute of science had been rejected by the government. The *communiqué* points out that a year ago the government made financial concessions which cleared the ground of the pecuniary difficulties previously existing, and the principal question which remained under discussion was the procedure for the valuation of the trust property. The government of Bombay has recently been communicated with as to the progress made in this and other essential preliminaries, and when these have been carried out the needful legislation will be introduced. So far from having rejected Mr. Tata's offer, the government of India have promised a large subsidy to the scheme, and they have throughout the negotiations 'done everything within their power to facilitate the progress and to aid the realization of a project which has their fullest sympathy." In its detailed memoir of Mr. Tata, the *Times of India* says that there is every probability that the scheme will sooner or later come into force, but, in case it did not, it was Mr. Tata's intention to divert the proposed endowment to another trust, which would enable Indian students to proceed to Europe to qualify for the Indian civil and other services and for the electrical and engineering professions until such time as it became possible, with the proper aid of government, to start the research institute as originally planned.

*Nature* states that at a sale recently held by Mr. Stevens in King Street, Covent Garden, a great auk's egg in fine condition was sold for two hundred guineas, the purchaser being Mr. Pax. This is a considerable fall-

ing-off from the three hundred guineas obtained for the last specimen sold by Mr. Stevens, the reason being attributed to the fact that several other fine examples are in the market. Mr. Pax's specimen was originally bought for two sovereigns. The next highest price obtained at the recent sale was £8 18s. 6d. for a clutch of four eggs of Bonaparte's sandpiper. For a single egg, the highest price was 27s. 6d. for one of Pallas's sand-grouse.

The annual return showing the number of experiments performed in Great Britain on living animals during the year 1903 has been issued as a parliamentary paper. According to the abstract in the London *Times* the total number of licensees was 347, of whom 97 performed no experiments. Evidence is afforded showing that licenses and certificates have been granted and allowed only upon the recommendation of persons of high scientific standing; that the licensees are persons who, by their training and education, are fitted to undertake experimental work and to profit by it; and that all experimental work has been conducted in suitable places. The total number of experiments was 19,084, being 4,178 performed with anesthetics and 16,913 without, more than in 1902. Of the total, 2,171 were anesthetics. In no case was a cutting operation more severe than a superficial venesection allowed to be performed with anesthetics. The experiments performed without anesthetics were mostly inoculations; a few were feeding experiments, or the administration of various substances by the mouth, or the abstraction of a minute quantity of blood for examination. In no instance was a certificate dispensing with anesthetics allowed for an experiment involving a serious operation. Operative procedures performed without anesthetics were only such as were attended by no considerable pain. In a very large number of such experiments the results were negative and the animals suffered no inconvenience from the inoculation. The usual inspection of registered places found the animals everywhere well lodged and cared for. Only two irregularities were reported.

## UNIVERSITY AND EDUCATIONAL NEWS.

At the recent commencement exercises of Columbia University a gift of $250,000 from Mr. Lewisohn was announced, to be used for a building for the School of Mines.

The sum of $325,000 has been collected for MacAlaster College in Minnesota. The largest gifts were $100,000 from Mr. C. D. Dayton and $50,000 from Mr. J. J. Hill.

A new physiological laboratory, erected at a cost of $125,000, has been opened at the University of Vienna.

President E. A. Alderman, of Tulane University, has been elected president of the University of Virginia. The University of Virginia, in accordance with the democratic ideas of Jefferson, has hitherto been governed by a board of visitors and the faculty without a president.

The removal of Professor John Dewey from the University of Chicago to Columbia University has led to certain changes in the department of philosophy and education at Chicago. Psychology has been made a separate department, with Professor James R. Angell at the head, and Professor James H. Tufts has been promoted to the head of the department of philosophy. It is further reported that Mr. John H. Locke will be made head of the School of Education.

Professor J. W. Gregory, of Melbourne, and formerly of the British Museum, has been elected to the chair of geology at Glasgow University.

Mr. F. G. Donnan, Ph.D., lecturer in chemistry in the Royal College of Science, Dublin, has been appointed to the Brunner chair of physical chemistry in the University of Liverpool.

The council of the University of Birmingham has conferred the honorary title of professor of geography on Mr. W. W. Watts, M.A., F.R.S., assistant professor of geology.

The University of Vienna has officially recognized work in radiology in the medical faculty. Dr. Leopold Freund, Dr. Robert Kienböck and Dr. Guido Holzknecht have been appointed docents in the subject.